



# 512K WORD × 16 BIT LOW POWER PSEUDO SRAM

## Table of Contents-

1. GENERAL DESCRIPTION.....	3
2. FEATURES .....	3
3. PRODUCT OPTIONS .....	3
4. BALL CONFIGURATION .....	4
5. BALL DESCRIPTION .....	4
6. BLOCK DIAGRAM .....	5
7. FUNCTION TRUTH TABLE .....	6
8. ELECTRICAL CHARACTERISTICS .....	7
Absolute Maximum Ratings .....	7
Recommended Operating Conditions.....	7
Capacitance .....	8
DC Characteristics .....	8
AC Characteristics .....	9
Read Operation .....	9
Write Operation.....	11
Power Down and Power Down Program Parameters .....	13
Other Timing Parameters .....	13
AC Test Conditions.....	13
9. TIMING WAVEFORMS .....	14
Read Timing #1 ( $\overline{\text{OE}}$ Control Access).....	14
Read Timing #2 ( $\overline{\text{CE1}}$ Control Access) .....	15
Read Timing #3 (Address Access after $\overline{\text{OE}}$ Control Access).....	16
Read Timing #4 (Address Access after $\overline{\text{CE1}}$ Control Access) .....	17
Write Timing #1 ( $\overline{\text{CE1}}$ Control) .....	18
Write Timing #2-1 ( $\overline{\text{WE}}$ Control, Single Write Operation) .....	19
Write Timing #2 ( $\overline{\text{WE}}$ Control, Continuous Write Operation).....	20
Read/Write Timing #1-1 ( $\overline{\text{CE1}}$ Control) .....	21
Read/Write Timing #1-2 ( $\overline{\text{CE1}}$ Control).....	22



---

Read ( $\overline{\text{OE}}$ Control) / Write ( $\overline{\text{WE}}$ Control) Timing #2-1.....	23
Read ( $\overline{\text{OE}}$ Control) / Write ( $\overline{\text{WE}}$ Control) Timing #2-2.....	24
Power Down Program Timing .....	25
Power Down Entry and Exit Timing.....	25
Power-up Timing #1 .....	25
Power-up Timing #2 .....	26
Standby Entry Timing after Read or Write .....	26
Data Retention .....	27
Low VDD Characteristics.....	27
Data Retention Timing .....	27
10. PACKAGE DIMENSION.....	28
TFBGA 48 Balls (6 x 8 mm <sup>2</sup> , pitch 0.75 mm).....	28
11. ORDERING INFORMATION.....	29
12. VERSION HISTORY .....	30

## 1. GENERAL DESCRIPTION

W963L6ABN is a 8M bits CMOS pseudo static random access memory (Pseudo SRAM), organized as 512K words x 16 bits. Using advanced single transistor DRAM architecture and 0.175  $\mu\text{m}$  process technology; W963L6ABN delivers fast access cycle time and low power consumption. It is suitable for mobile device application such as Cellular Phone and PDA, which high-density buffer is needed and power dissipation is most concerned.

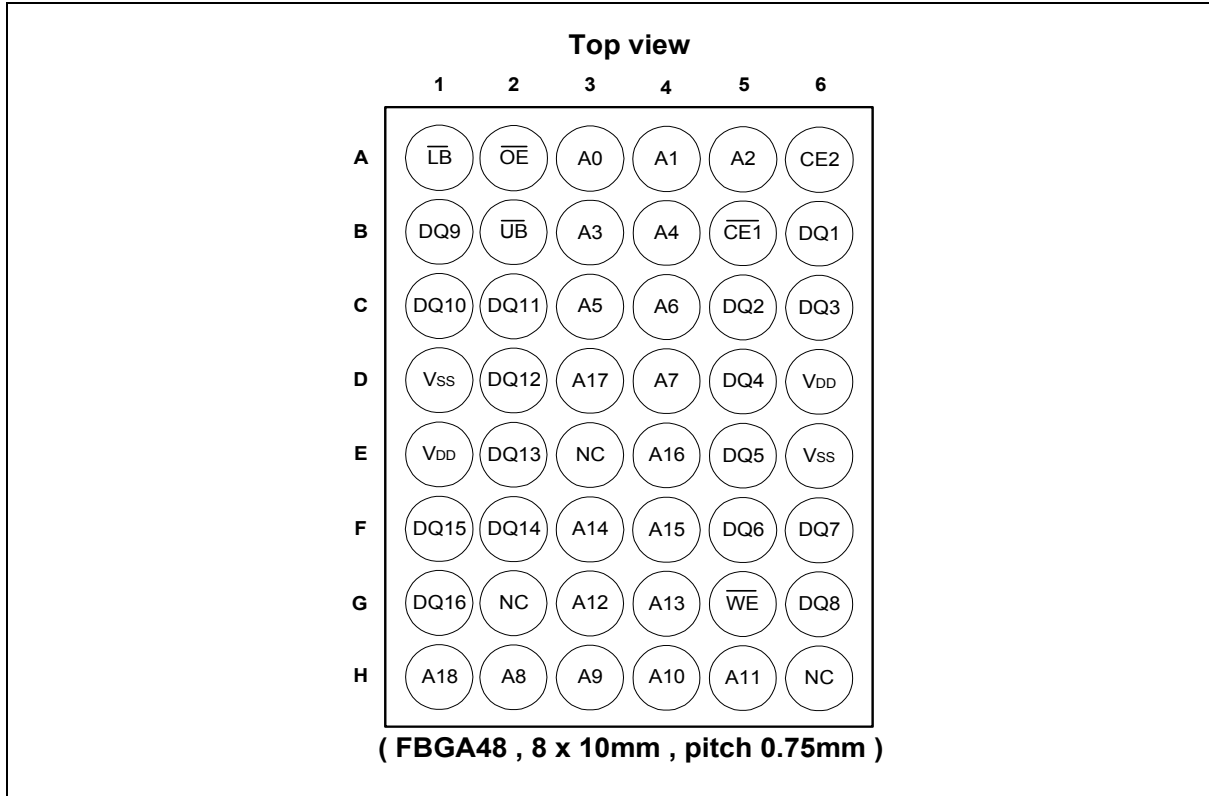
## 2. FEATURES

- Asynchronous SRAM interface
- Fast access cycle time:
  - $t_{RC} = 70 \text{ nS} (-70), 80 \text{ nS} (-80)$
- Low power consumption:
  - $I_{DDA1} = 20 \text{ mA Max.}$
  - $I_{DDS1} = 70 \mu\text{A Max.}$
- Byte write control
- Wide operating conditions:
  - $V_{DD} = +2.3\text{V to } +2.7\text{V or } +2.7\text{V to } +3.3\text{V}$
- Temperature
  - $T_A = 0^\circ\text{C to } +70^\circ\text{C}$
  - $T_A = -25^\circ\text{C to } +85^\circ\text{C (Extended temperature)}$
  - $T_A = -40^\circ\text{C to } +85^\circ\text{C (Industrial temperature)}$

## 3. PRODUCT OPTIONS

PARAMETER	W963L6ABN70	W963L6ABN80
$t_{RC}$	70 nS Min.	80 nS Min.
$I_{DDS1}$	70 $\mu\text{A Max.}$	70 $\mu\text{A Max.}$
$I_{DDA1}$	20 mA	20 mA
$V_{DD}$	2.3V to 2.7V 2.7V to 3.3V	2.3V to 2.7V 2.7V to 3.3V

#### 4. BALL CONFIGURATION

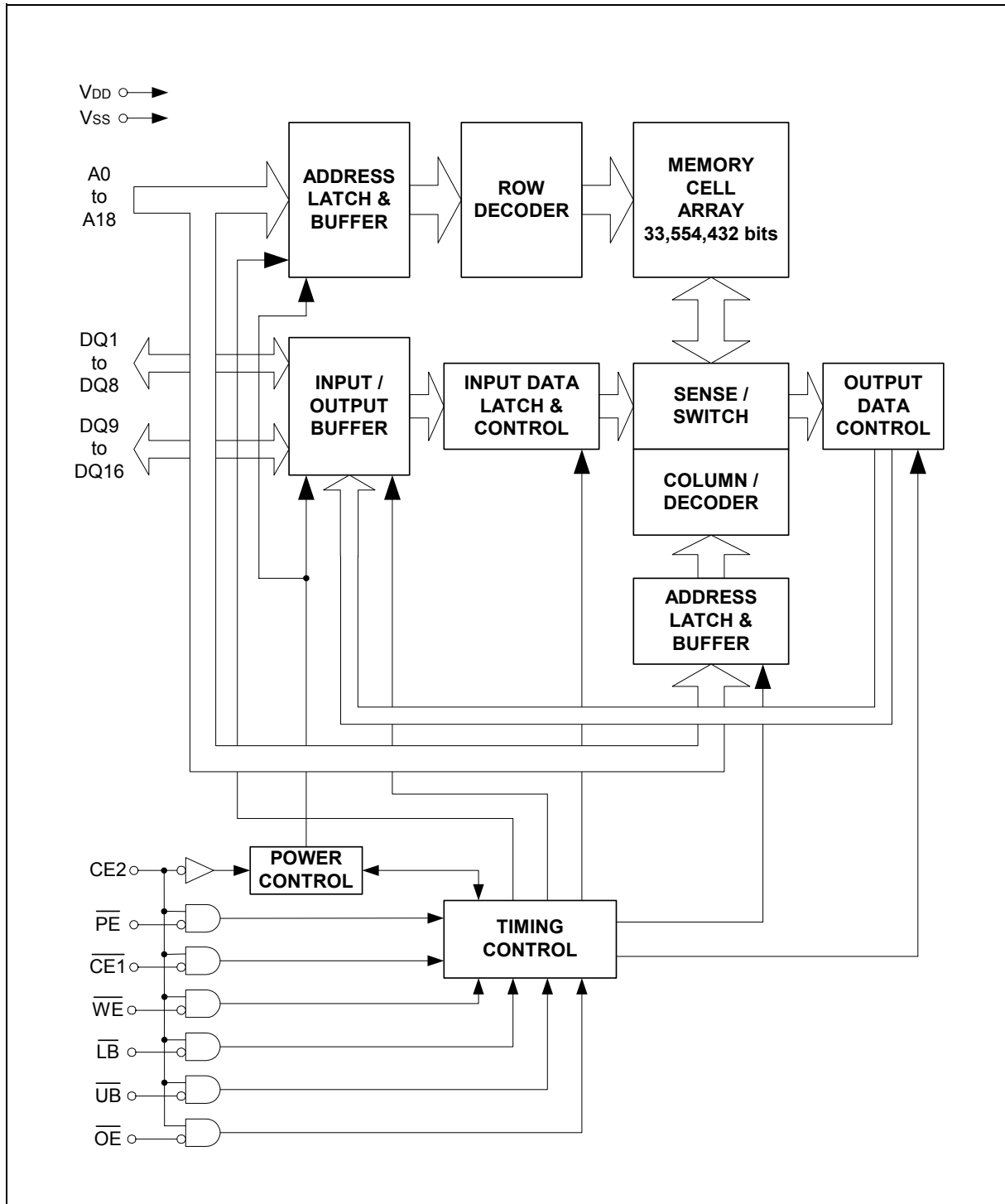


#### 5. BALL DESCRIPTION

SYMBOL	DESCRIPTION
A0 – A18	Address Input
CE1	Chip Enable Input 1, Low: Enable
CE2	Chip Enable Input 2, High: Enable, Low: Enter Power Down Mode
WE	Write Enable Input
OE	Output Enable Input
LB	Lower Byte Write Control
UB	Upper Byte Write Control
I/O1 – I/O16	Data Inputs/Outputs
VDD	Power Supply
Vss	Ground
NC	No Connection



6. BLOCK DIAGRAM





## 7. FUNCTION TRUTH TABLE

MODE	NOTE	CE2	$\overline{\text{CE1}}$	$\overline{\text{WE}}$	$\overline{\text{OE}}$	$\overline{\text{LB}}$	$\overline{\text{UB}}$	A0-18	DQ1-8	DQ9-16	I <sub>DD</sub>	DATA RETENTION
Standby (Deselect)		H	H	X	X	X	X	X	High-Z	High-Z	I <sub>DDS</sub>	Yes
Power Down Program	*1			X	X	X	X	KEY *6	High-Z	High-Z		I <sub>DDA</sub>
Output Disable	*2		L	H	H	X	X	*7	High-Z	High-Z	Yes	
No Read				H	L	H	H	Valid	High-Z	High-Z		
Read	*3			L	*5	Valid	Output Valid	Output Valid				
Write (Upper Byte)				H	L	Valid	Invalid	Input Valid				
Write (Lower Byte)				L	H	Valid	Input Valid	Invalid				
Write (Word)				L	L	Valid	Input Valid	Input Valid				
Power Down	*4	L	X	X	X	X	X	X	High-Z	High-Z	I <sub>DDP</sub>	No/Yes

**Notes:** L = V<sub>IL</sub>, H = V<sub>IH</sub>, X can be either V<sub>IL</sub> or V<sub>IH</sub>, High-Z = High impedance, KEY = Key Address.

\*1: The Power Down Program can be performed one time after compliance of Power-up timings and it should not be re-programmed after regular Read or Write.

\*2: Output Disable mode should not be kept longer than 1  $\mu$ S.

\*3: Byte control at Read mode is not supported.

\*4: Power Down mode can be entered from Standby state and all DQ pins are in High-Z state. I<sub>DDP</sub> current and data retention depend on the selection of Power Down Program.

\*5: Either or both  $\overline{\text{LB}}$  and  $\overline{\text{UB}}$  must be Low for Read operation.

\*6: See "Power Down Program Key Table" in next page for details.

\*7: Can be either V<sub>IL</sub> or V<sub>IH</sub> but must be valid before Read or Write.



## 8. ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings

PARAMETER	SYMBOL	VALUE	UNIT
Voltage of V <sub>DD</sub> Supply Relative to V <sub>SS</sub>	V <sub>DD</sub>	-0.5 to +3.6	V
Voltage at Any Pin Relative to V <sub>SS</sub>	V <sub>IN</sub> , V <sub>OUT</sub>	-0.5 to +3.6	V
Short Circuit Output Current	I <sub>OUT</sub>	± 50	mA
Storage Temperature	T <sub>STG</sub>	-55 to +125	°C

**WARNING:** Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

### Recommended Operating Conditions

(Reference to V<sub>SS</sub>)

PARAMETER	NOTES	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage		V <sub>DD</sub> (27)	2.7	3.3	V
		V <sub>DD</sub> (23)	2.3	2.7	V
		V <sub>SS</sub>	0	0	V
High Level Input Voltage	*1	V <sub>IH</sub> (27)	2.2	V <sub>DD</sub> +0.3	V
		V <sub>IH</sub> (23)	2.0	V <sub>DD</sub> +0.3	V
Low Level Input Voltage	*2	V <sub>IL</sub> (27)	-0.3	0.5	V
		V <sub>IL</sub> (23)	-0.3	0.4	V
Ambient Temperature		T <sub>A</sub>	0	70	°C
Ambient Temperature		T <sub>A</sub>	-25	85	°C
Ambient Temperature		T <sub>A</sub>	-40	85	°C

**Notes:**

\*1: Maximum DC voltage on input and I/O pins are V<sub>DD</sub> +0.3V. During voltage transitions, inputs may positive overshoot to V<sub>DD</sub> +1.0V for periods of up to 5 nS.

\*2: Minimum DC voltage on input and I/O pins are -0.3V. During voltage transitions, inputs may negative overshoot to -1.0V for periods of up to 5 nS.

**WARNING:** Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the datasheet. Users considering application outside the listed conditions are advised to contact their Winbond representative beforehand.



## Capacitance

Test conditions:  $T_A = 25^\circ\text{C}$ ,  $f = 1.0\text{ MHz}$

SYMBOL	DESCRIPTION	TEST SETUP	TYP.	MAX.	UNIT
CIN1	Address Input Capacitance	$V_{IN} = 0V$	-	5	pF
CIN2	Control Input Capacitance	$V_{IN} = 0V$	-	5	pF
CIO	Data Input/Output Capacitance	$V_{IO} = 0V$	-	8	pF

## DC Characteristics

(Under Recommended Operating Conditions unless otherwise noted)

notes \*1, \*2, \*3

PARAMETER		SYM.	TEST CONDITIONS	MIN.	MAX.	UNIT	
Input Leakage Current		I <sub>LI</sub>	$V_{IN} = V_{SS}$ to $V_{DD}$	-1.0	+1.0	$\mu\text{A}$	
Output Leakage Current		I <sub>LO</sub>	$V_{OUT} = V_{SS}$ to $V_{DD}$ , Output Disable	-1.0	+1.0	$\mu\text{A}$	
Output High Voltage Level		V <sub>OH</sub> (27)	$V_{DD} = V_{DD} (27)$ , I <sub>OH</sub> = -0.5 mA	2.2	-	V	
		V <sub>OH</sub> (23)	$V_{DD} = V_{DD} (23)$ , I <sub>OH</sub> = -0.5 mA	1.8	-	V	
Output Low Voltage Level		V <sub>OL</sub>	I <sub>OL</sub> = 1mA	-	0.4	V	
Standby Current	(TTL)	I <sub>DDS</sub>	$V_{DD} = V_{DD} \text{ Max.}$ , $\overline{V_{IN}} = V_{IH}$ or $V_{IL}$ $CE1 = CE2 = V_{IH}$	-	3	mA	
	(CMOS)	I <sub>DDS1</sub>	$V_{DD} = V_{DD} \text{ Max.}$ , $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{DD} - 0.2V$ , $CE1 = CE2 \geq V_{DD} - 0.2V$	-	70	$\mu\text{A}$	
Active Current		I <sub>DDA1</sub>	$V_{DD} = V_{DD} \text{ Max.}$ , $\overline{V_{IN}} = V_{IH}$ or $V_{IL}$ ,	$t_{RC} / t_{WC} =$ minimum	-	20	mA
		I <sub>DDA2</sub>	$CE1 = V_{IL}$ and $CE2 = V_{IH}$ , I <sub>OUT</sub> = 0 mA	$t_{RC} / t_{WC} =$ 1 $\mu\text{S}$	-	3	mA

### Notes:

- \*1: All voltages are reference to  $V_{SS}$ .
- \*2: DC Characteristics are measured after following POWER-UP timing.
- \*3: I<sub>OUT</sub> depends on the output load conditions.





## AC Characteristics

(Under Recommended Operating Conditions unless otherwise noted)

### Read Operation

PARAMETER	SYM.	-70		-80		UNIT	NOTES
		Min.	Max.	Min.	Max.		
Read Cycle Time	$t_{RC}$	70	-	80	-	nS	
Chip Enable Access Time	$t_{CE}$	-	65	-	75	nS	*1, *3
Output Enable Access Time	$t_{OE}$	-	40	-	45	nS	*1
Address Access Time	$t_{AA}$	-	65	-	75	nS	*1
Output Data Hold Time	$t_{OH}$	5	-	5	-	nS	*1
$\overline{CE1}$ Low to Output Low-Z	$t_{CLZ}$	5	-	5	-	nS	*2
$\overline{OE}$ Low to Output Low-Z	$t_{OLZ}$	0	-	0	-	nS	*2
$\overline{CE1}$ High to Output High-Z	$t_{CHZ}$	-	20	-	25	nS	*2
$\overline{OE}$ High to Output High-Z	$t_{OHZ}$	-	20	-	25	nS	*2
Address Setup Time to $\overline{CE1}$ Low	$t_{ASC}$	-5	-	-5	-	nS	*4
Address Setup Time to $\overline{OE}$ Low	$t_{ASO}$	30	-	35	-	nS	*3, *5
	$t_{ASO[ABS]}$	10	-	10	-	nS	*6
$\overline{LB} / \overline{UB}$ Setup Time to $\overline{CE1}$ Low	$t_{BSC}$	-5	-	-5	-	nS	
$\overline{LB} / \overline{UB}$ Setup Time to $\overline{OE}$ Low	$t_{BSO}$	10	-	10	-	nS	
Address Invalid Time	$t_{AX}$	-	5	-	5	nS	
Address Hold Time from $\overline{CE1}$ Low	$t_{CLAH}$	70	-	80	-	nS	
Address Hold Time from $\overline{OE}$ Low	$t_{OLAH}$	40	-	45	-	nS	*9
Address Hold Time from $\overline{CE1}$ High	$t_{CHAH}$	-5	-	-5	-	nS	
Address Hold Time from $\overline{OE}$ High	$t_{OHAH}$	-5	-	-5	-	nS	
$\overline{LB} / \overline{UB}$ Hold Time from $\overline{CE1}$ High	$t_{CHBH}$	-5	-	-5	-	nS	
$\overline{LB} / \overline{UB}$ Hold Time from $\overline{OE}$ High	$t_{OHBH}$	-5	-	-5	-	nS	
$\overline{CE1}$ Low to $\overline{OE}$ Low Delay Time	$t_{CLOL}$	25	1000	30	1000	nS	*3, *5, *7, *8
$\overline{OE}$ Low to $\overline{CE1}$ High Delay Time	$t_{OLCH}$	35	-	40	-	nS	*7
$\overline{CE1}$ High Pulse Width	$t_{CP}$	12	-	15	-	nS	
$\overline{OE}$ High Pulse Width	$t_{OP}$	25	1000	30	1000	nS	*5, *7, *8
	$t_{OP[ABS]}$	12	-	15	-	nS	*6



## Read Operation, Continued

### Notes:

- \*1: The output load is 50 pF at  $V_{DD}$  (27) and 30 pF at  $V_{DD}$  (23).
- \*2: The output load is 5 pF.
- \*3: The  $t_{CE}$  is applicable if  $\overline{OE}$  is brought to Low before  $\overline{CE1}$  goes Low and is also applicable if actual value of both or either  $t_{ASO}$  or  $t_{CLOL}$  is shorter than specified value.
- \*4: Applicable if  $\overline{OE}$  is brought to Low before  $\overline{CE1}$  goes Low.
- \*5: The  $t_{ASO}$ ,  $t_{CLOL}(\min.)$  and  $t_{OP}(\min.)$  are reference values when the access time is determined by  $t_{OE}$ . If actual value of each parameter is shorter than specified minimum value,  $t_{OE}$  become longer by the amount of subtracting actual value from specified minimum value.  
  
For example, if actual  $t_{ASO}$ ,  $t_{ASO}(\text{actual})$ , is shorter than specified minimum value,  $t_{ASO}(\min.)$ , during  $\overline{OE}$  control access (ie.,  $\overline{CE1}$  stays Low), the  $t_{OE}$  become  $t_{OE}(\max.) + t_{ASO}(\min.) - t_{ASO}(\text{actual})$ .
- \*6: The  $t_{ASO}[\text{ABS}]$  and  $t_{OP}[\text{ABS}]$  is the absolute minimum value during  $\overline{OE}$  control access.
- \*7: If actual value of either  $t_{CLOL}$  or  $t_{OP}$  is shorter than specified minimum value, both  $t_{OLAH}$  and  $t_{OLCH}$  become  $t_{RC}(\min.) - t_{CLOL}(\text{actual})$  or  $t_{RC}(\min.) - t_{OP}(\text{actual})$ .
- \*8: Maximum value is applicable if  $\overline{CE1}$  is kept at low.



AC Characteristics, Continued

## Write Operation

PARAMETER	SYM.	-70		-80		UNIT	NOTES
		Min.	Max.	Min.	Max.		
Write Cycle Time	t <sub>WC</sub>	70	-	80	-	nS	*1
Address Setup Time	t <sub>AS</sub>	0	-	0	-	nS	*2
Address Hold Time	t <sub>AH</sub>	35	-	40	-	nS	*2
$\overline{\text{CE1}}$ Write Setup Time	t <sub>CS</sub>	0	1000	0	1000	nS	
$\overline{\text{CE1}}$ Write Hold Time	t <sub>CH</sub>	0	1000	0	1000	nS	
$\overline{\text{WE}}$ Setup Time	t <sub>WS</sub>	0	-	0	-	nS	
$\overline{\text{WE}}$ Hold Time	t <sub>WH</sub>	0	-	0	-	nS	
$\overline{\text{LB}}$ and $\overline{\text{UB}}$ Setup Time	t <sub>BS</sub>	-5	-	-5	-	nS	
$\overline{\text{LB}}$ and $\overline{\text{UB}}$ Hold Time	t <sub>BH</sub>	-5	-	-5	-	nS	
$\overline{\text{OE}}$ Setup Time	t <sub>OES</sub>	0	1000	0	1000	nS	*3
$\overline{\text{OE}}$ Hold Time	t <sub>OEH</sub>	30	1000	35	1000	nS	*3, *4
	t <sub>OEH[ABS]</sub>	12	-	15	-	nS	*5
$\overline{\text{OE}}$ High to $\overline{\text{CE1}}$ Low Setup Time	t <sub>OHCL</sub>	-5	-	-5	-	nS	*6
$\overline{\text{OE}}$ High to Address Hold Time	t <sub>OH AH</sub>	-5	-	-5	-	nS	*7
$\overline{\text{CE1}}$ Write Pulse Width	t <sub>CW</sub>	45	-	50	-	nS	*1, *8
$\overline{\text{WE}}$ Write Pulse Width	T <sub>WP</sub>	45	-	50	-	nS	*1, *8
$\overline{\text{CE1}}$ Write Recovery Time	t <sub>WRC</sub>	10	-	15	-	nS	*1, *9
$\overline{\text{WE}}$ Write Recovery Time	t <sub>WR</sub>	10	1000	15	1000	nS	*1, *3, *9
Data Setup Time	t <sub>DS</sub>	15	-	20	-	nS	
Data Hold Time	t <sub>DH</sub>	0	-	0	-	nS	
$\overline{\text{CE1}}$ High Pulse Width	t <sub>CP</sub>	12	-	15	-	nS	*9



## Write Operation, Continued

### Notes:

- \*1: Minimum value must be equal or greater than the sum of actual  $t_{CW}$  (or  $t_{WP}$ ) and  $t_{WRC}$  (or  $t_{WR}$ ).
- \*2: New write address is valid from either  $\overline{CE1}$  or  $\overline{WE}$  is brought to High.
- \*3: The  $t_{OE}$  is specified from end of  $t_{WC}(\min)$ . The  $t_{OE}(\min)$  is a reference value when the access time is determined by  $t_{OE}$ .  
If actual value,  $t_{OE}(\text{actual})$  is shorter than specified minimum value,  $t_{OE}$  become longer by the amount of subtracting actual value from specified minimum value.
- \*4: The  $t_{OE}(\max)$  is applicable if  $\overline{CE1}$  is kept at Low and both  $\overline{WE}$  and  $\overline{OE}$  are kept at High.
- \*5: The  $t_{OE}[\text{ABS}]$  is the absolute minimum value if write cycle is terminated by  $\overline{WE}$  and  $\overline{CE1}$  stays Low.
- \*6:  $t_{OHCL}(\min)$  must be satisfied if read operation is not performed prior to write operation.  
In case  $\overline{OE}$  is disabled after  $t_{OHCL}(\min.)$ ,  $\overline{WE}$  Low must be asserted after  $t_{RC}(\min.)$  from  $\overline{CE1}$  Low. In other words, read operation is initiated if  $t_{OHCL}(\min.)$  is not satisfied.
- \*7: Applicable if  $\overline{CE1}$  stays Low after read operation.
- \*8:  $t_{CW}$  and  $t_{WP}$  is applicable if write operation is initiated by  $\overline{CE1}$  and  $\overline{WE}$ , respectively.
- \*9:  $t_{WRC}$  and  $t_{WR}$  is applicable if write operation is terminated by  $\overline{CE1}$  and  $\overline{WE}$ , respectively.  
The  $t_{WR}(\min.)$  can be ignored if  $\overline{CE1}$  is brought to High together or after  $\overline{WE}$  is brought to High. In such case, the  $t_{CP}(\min.)$  must be satisfied.



AC Characteristics, Continued

### Power Down and Power Down Program Parameters

PARAMETER	SYM.	-70		-80		UNIT	NOTES
		Min.	Max.	Min.	Max.		
CE2 Low Setup Time for Power Down Entry	t <sub>CSP</sub>	10	-	10	-	nS	
CE2 Low Hold Time after Power Down Entry	t <sub>C2LP</sub>	70	-	80	-	nS	
CE1 High Setup Time following CE2 High after Power Down Exit	t <sub>CHS</sub>	10	-	10	-	nS	
CE1 High to PE Low Setup Time	t <sub>EPS</sub>	70	-	80	-	nS	*1

**Note:** \*1: Applicable to Power Down Program

### Other Timing Parameters

PARAMETER	SYM.	-70		-80		UNIT	NOTES
		Min.	Max.	Min.	Max.		
CE1 High to OE Invalid Time for Standby Entry	t <sub>CHOX</sub>	10	-	10	-	nS	
CE1 High to WE Invalid Time for Standby Entry	t <sub>CHWX</sub>	10	-	10	-	nS	*1
CE2 Low Hold Time after Power-up	t <sub>C2LH</sub>	50	-	50	-	μS	*2
CE2 High Hold Time after Power-up	t <sub>C2HL</sub>	50	-	50	-	μS	*3
CE1 High Hold Time following CE2 High after Power-up	t <sub>CHH</sub>	350	-	350	-	μS	*2
Input Transition Time	t <sub>T</sub>	1	25	1	25	nS	*4

**Notes:**

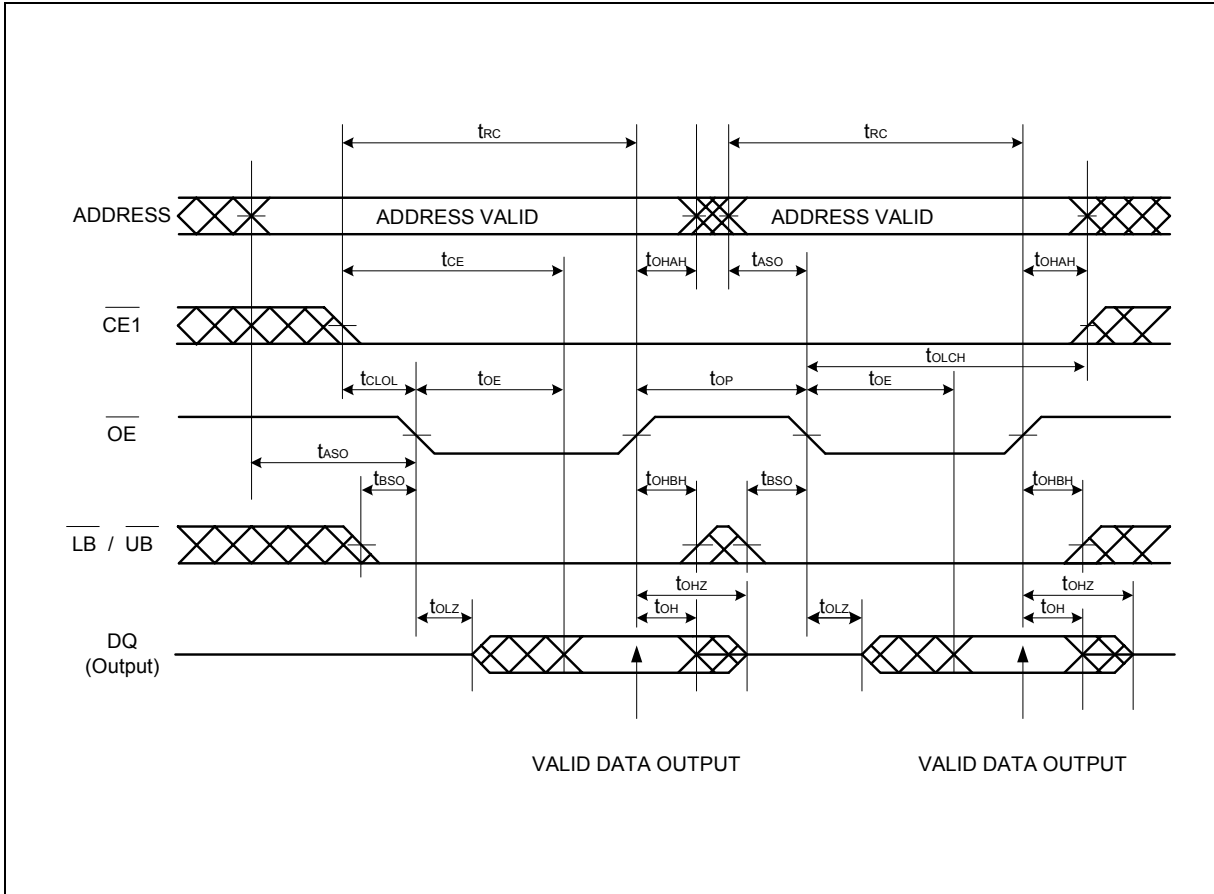
- \*1: Some data might be written into any address location if t<sub>CHWX</sub>(min.) is not satisfied.
- \*2: Must satisfy t<sub>CHH</sub>(min.) after t<sub>C2LH</sub>(min.).
- \*3: Requires Power Down mode entry and exit after t<sub>C2HL</sub>.
- \*4: The Input Transition Time (t<sub>T</sub>) at AC testing is 5 nS as shown in below. If actual t<sub>T</sub> is longer than 5 nS, it may violate AC specified of some timing parameters.

### AC Test Conditions

SYMBOL	DESCRIPTION	TEST SETUP	VALUE	UNIT	NOTE
V <sub>IH</sub>	Input High Level	V <sub>DD</sub> = 2.7V to 3.3V	2.3	V	
		V <sub>DD</sub> = 2.3V to 2.7V	2.0		
V <sub>IL</sub>	Input Low Level	V <sub>DD</sub> = 2.7V to 3.3V	0.4	V	
		V <sub>DD</sub> = 2.3V to 2.7V	0.4		
V <sub>REF</sub>	Input Timing Measurement Level	V <sub>DD</sub> = 2.7V to 3.3V	1.3	V	
		V <sub>DD</sub> = 2.3V to 2.7V	1.1		
T <sub>T</sub>	Input Transition Time	Between V <sub>IL</sub> and V <sub>IH</sub>	5	nS	

## 9. TIMING WAVEFORMS

### Read Timing #1 ( $\overline{\text{OE}}$ Control Access)



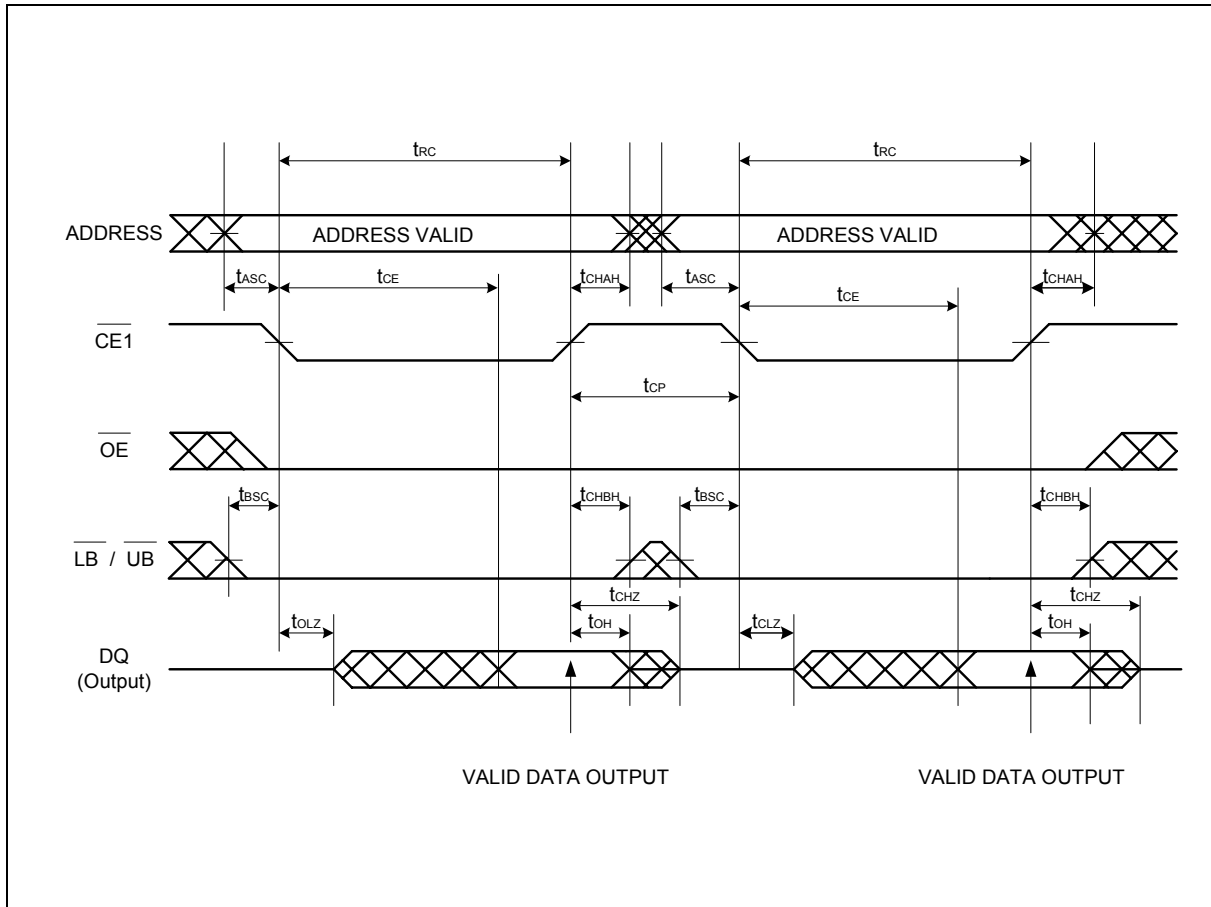
**Note:**  $\overline{\text{CE2}}$ ,  $\overline{\text{PE}}$  and  $\overline{\text{WE}}$  must be High for entire read cycle.

Either or both  $\overline{\text{LB}}$  and  $\overline{\text{UB}}$  must be Low when both  $\overline{\text{CE1}}$  and  $\overline{\text{OE}}$  are Low.



Timing Waveforms, Continued

## Read Timing #2 ( $\overline{\text{CE1}}$ Control Access)



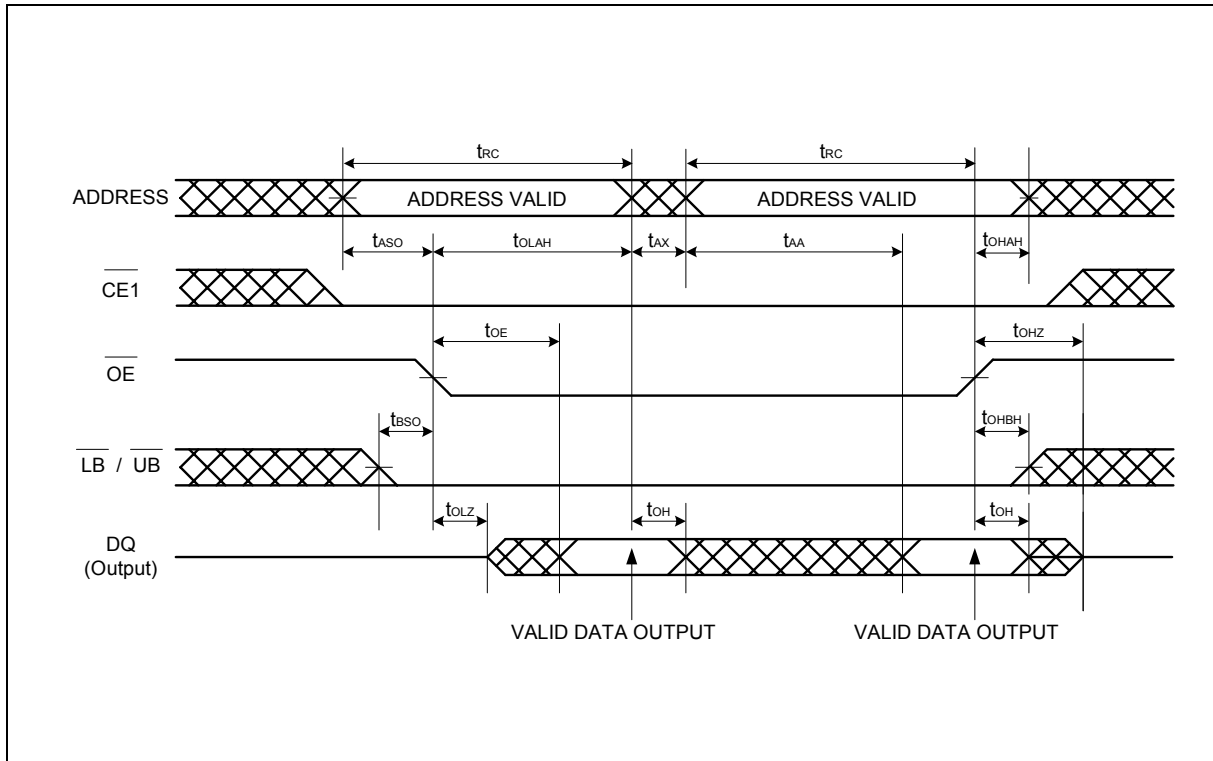
**Note:**  $\overline{\text{CE2}}$ ,  $\overline{\text{PE}}$  and  $\overline{\text{WE}}$  must be High for entire read cycle.

Either or both  $\overline{\text{LB}}$  and  $\overline{\text{UB}}$  must be Low when both  $\overline{\text{CE1}}$  and  $\overline{\text{OE}}$  are Low.



Timing Waveforms, Continued

## Read Timing #3 (Address Access after $\overline{\text{OE}}$ Control Access)



**Note:**  $\overline{\text{CE2}}$ ,  $\overline{\text{PE}}$  and  $\overline{\text{WE}}$  must be High for entire read cycle.

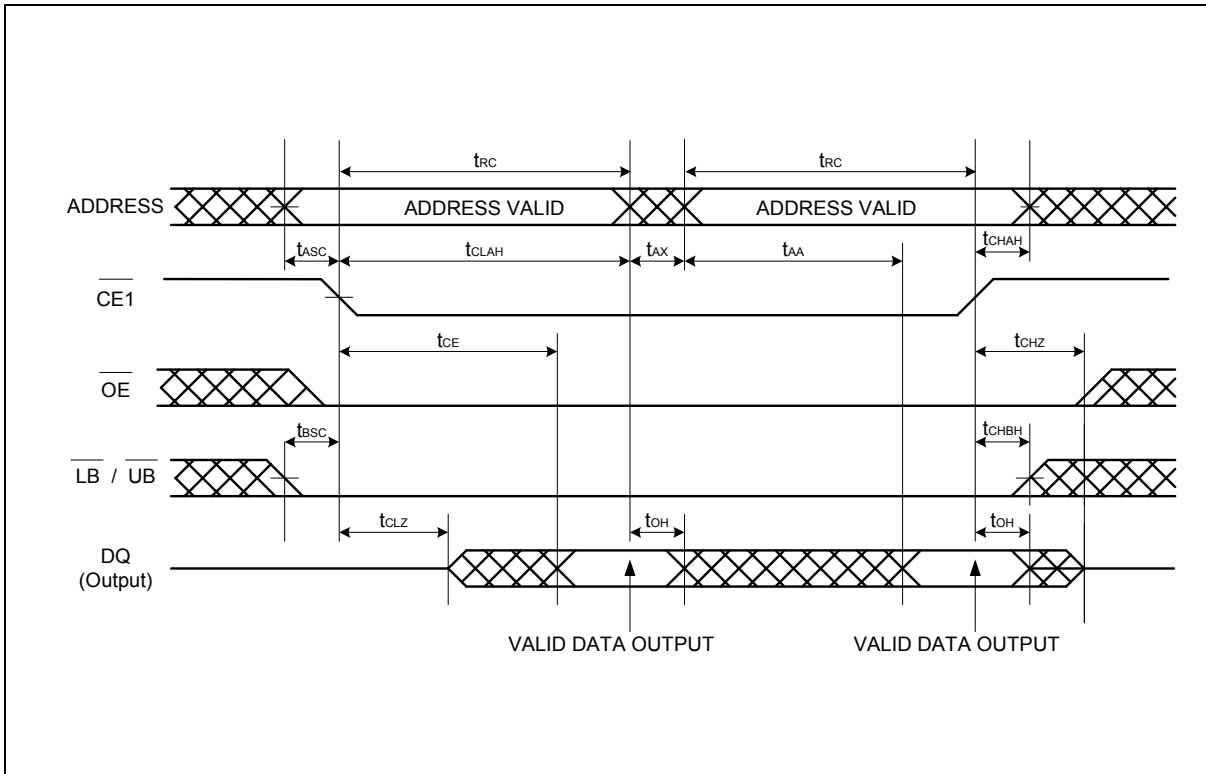
Either or both  $\overline{\text{LB}}$  and  $\overline{\text{UB}}$  must be Low when both  $\overline{\text{CE1}}$  and  $\overline{\text{OE}}$  are Low.





Timing Waveforms, Continued

**Read Timing #4 (Address Access after  $\overline{\text{CE1}}$  Control Access)**

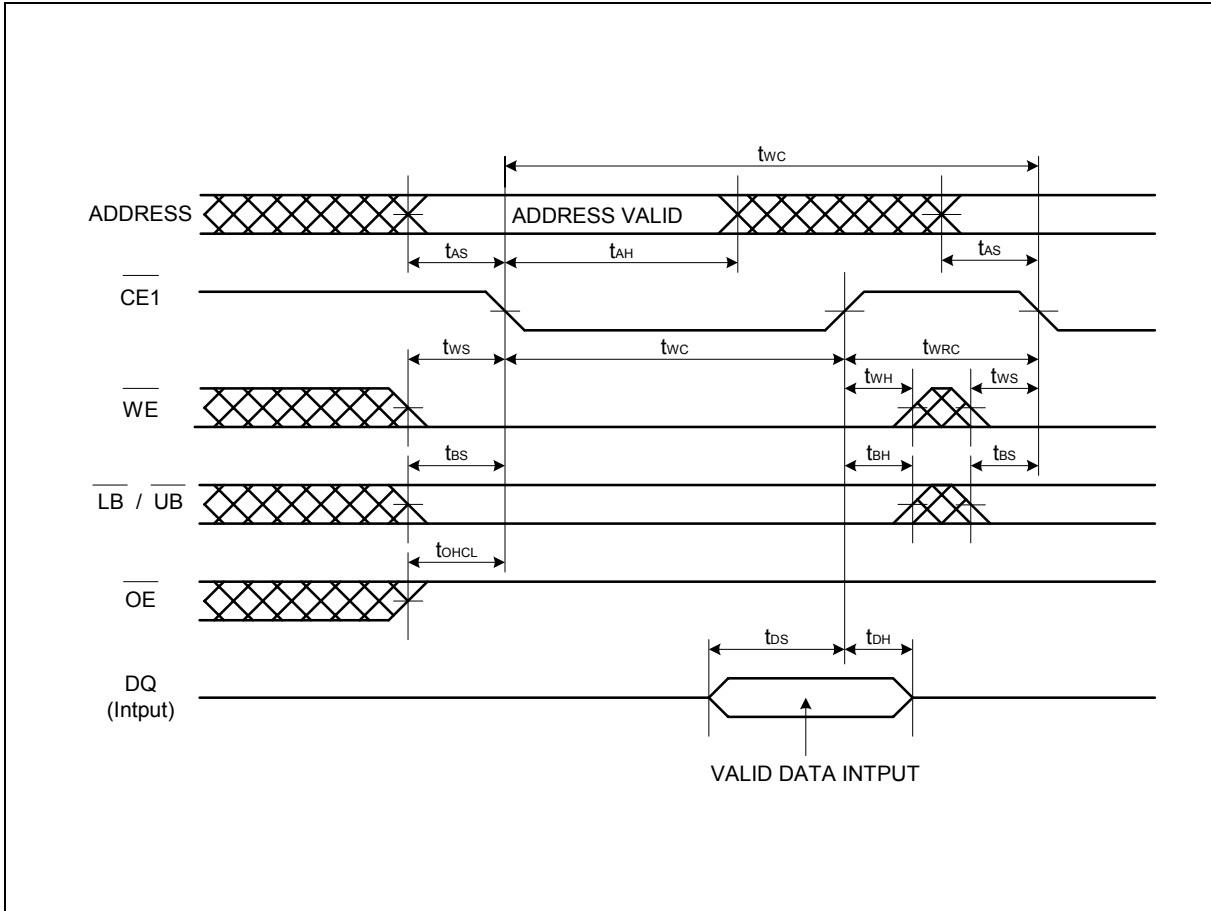


**Note:**  $\overline{\text{CE2}}$ ,  $\overline{\text{PE}}$  and  $\overline{\text{WE}}$  must be High for entire read cycle.  
 Either or both  $\overline{\text{LB}}$  and  $\overline{\text{UB}}$  must be Low when both  $\overline{\text{CE1}}$  and  $\overline{\text{OE}}$  are Low.



Timing Waveforms, Continued

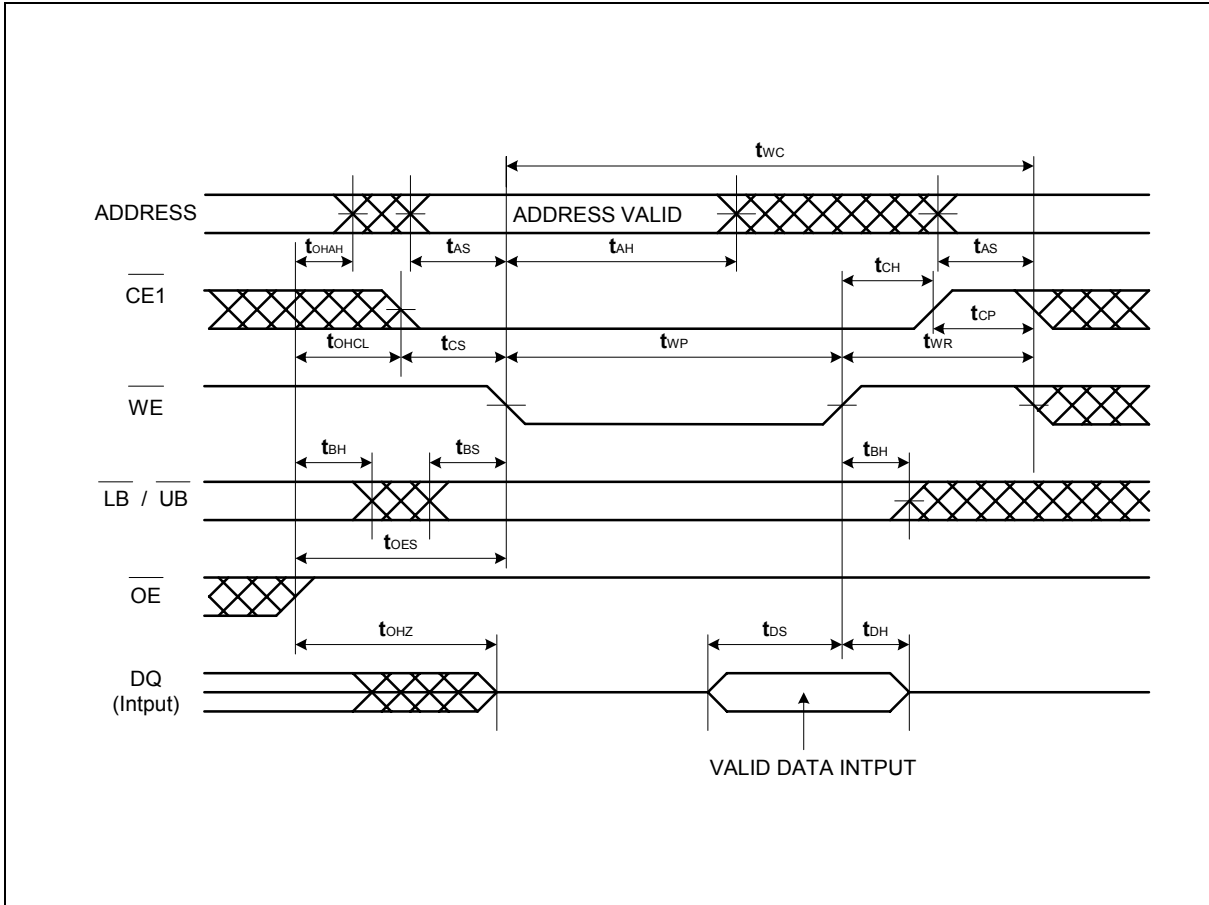
## Write Timing #1 ( $\overline{\text{CE1}}$ Control)



**Note:**  $\overline{\text{CE2}}$ , and  $\overline{\text{PE}}$  must be High for entire write cycle.

Timing Waveforms, Continued

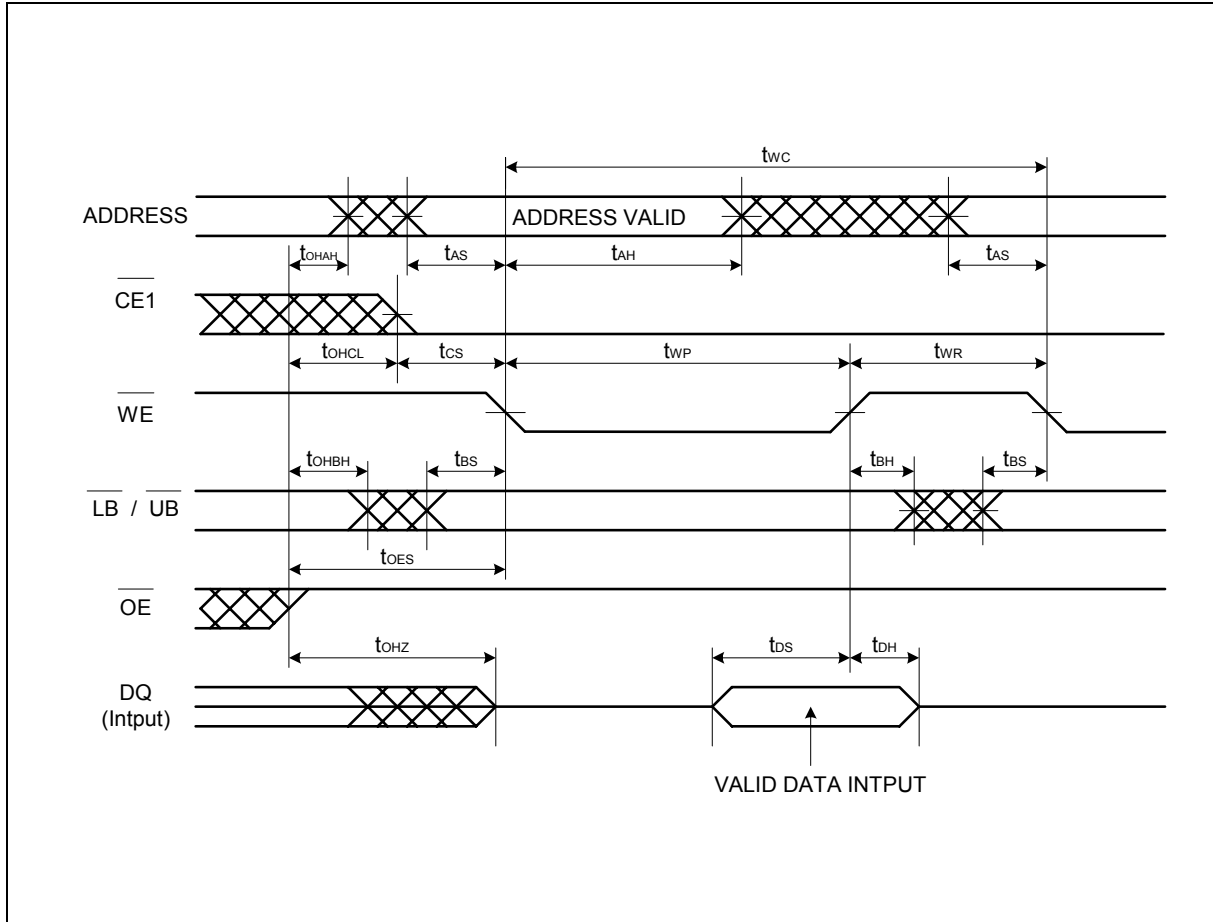
## Write Timing #2-1 ( $\overline{\text{WE}}$ Control, Single Write Operation)



**Note:** CE2 and  $\overline{\text{PE}}$  must be High for entire write cycle.

Timing Waveforms, Continued

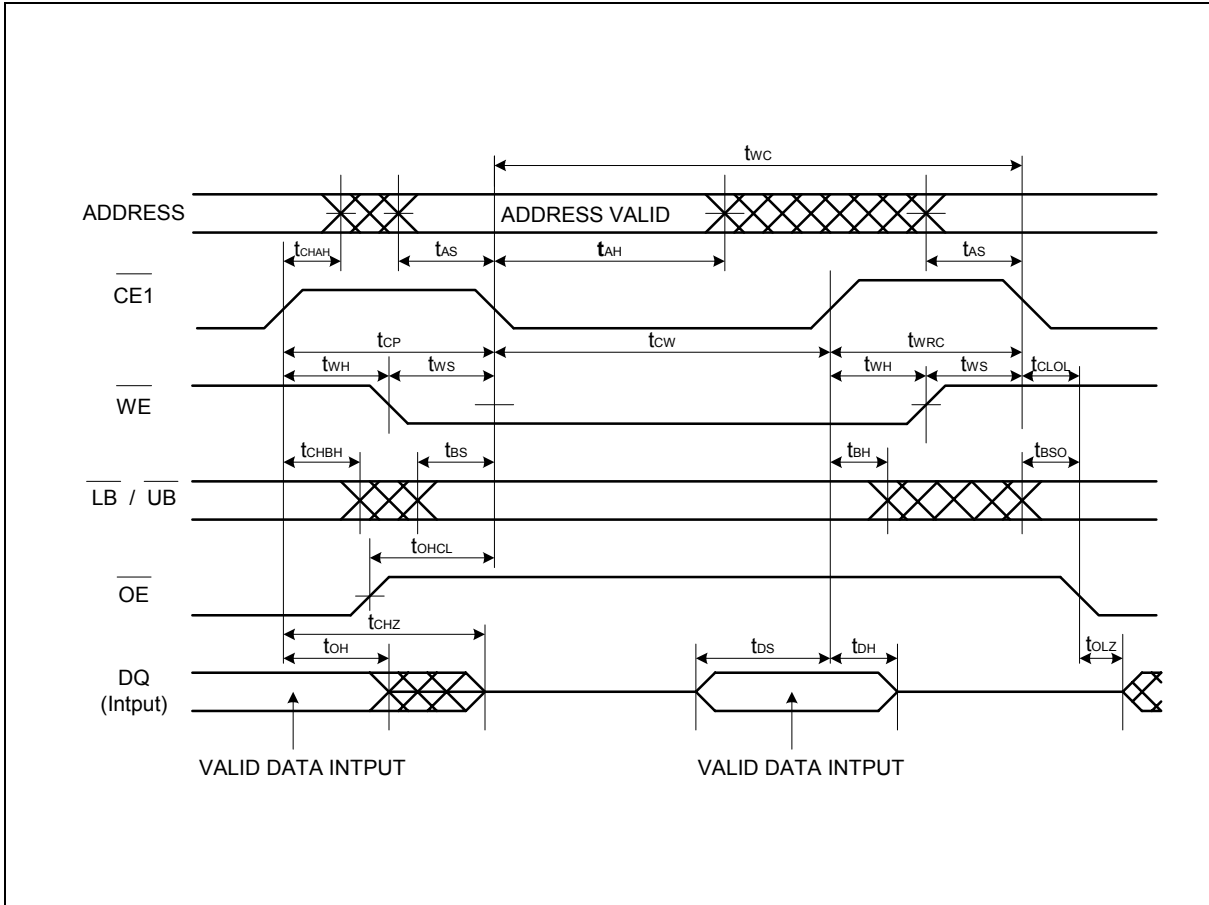
## Write Timing #2 ( $\overline{\text{WE}}$ Control, Continuous Write Operation)



**Note:**  $\overline{\text{CE2}}$  and  $\overline{\text{PE}}$  must be High for entire write cycle.

Timing Waveforms, Continued

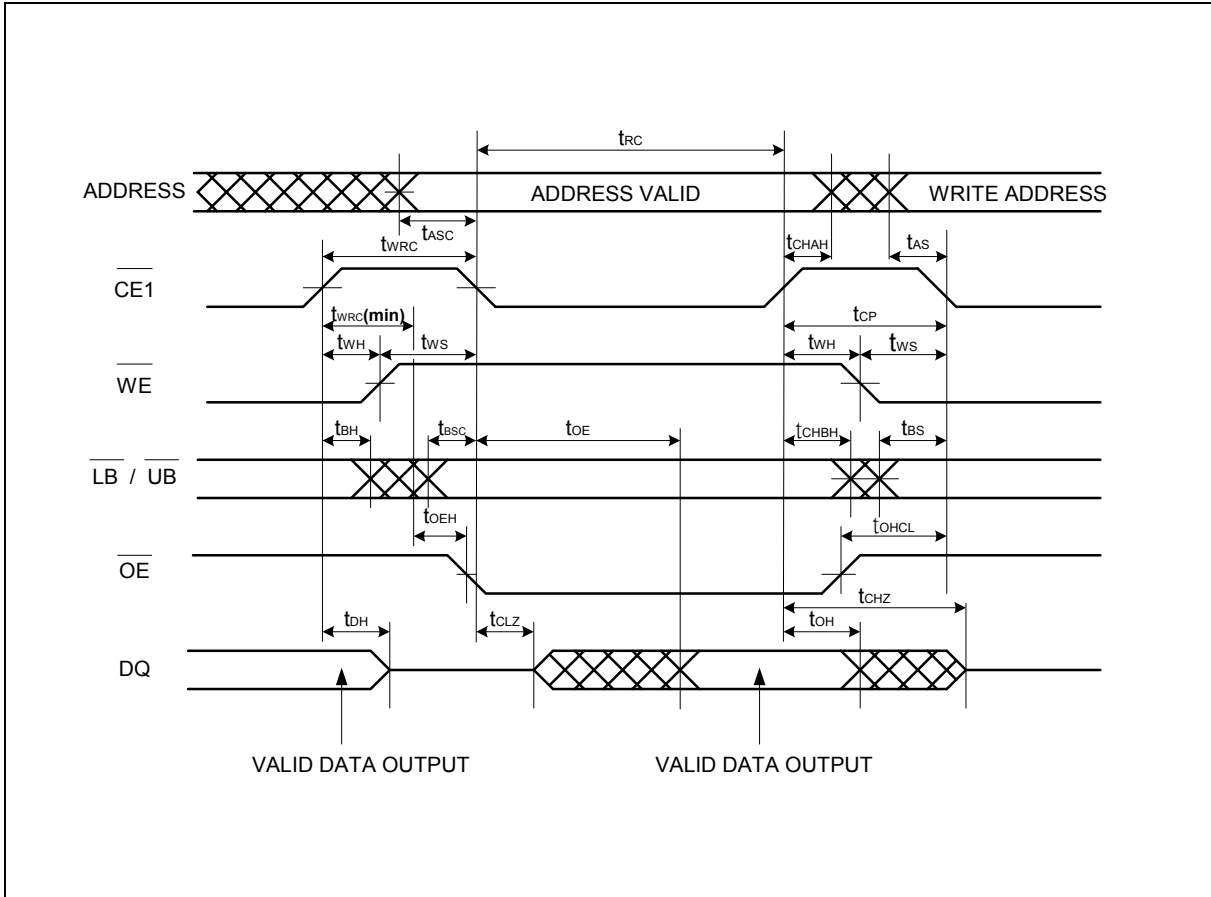
## Read/Write Timing #1-1 ( $\overline{\text{CE1}}$ Control)



**Note:** Write address is valid from either  $\overline{\text{CE1}}$  or  $\overline{\text{WE}}$  of last falling edge.

Timing Waveforms, Continued

## Read/Write Timing #1-2 (CE1 Control)

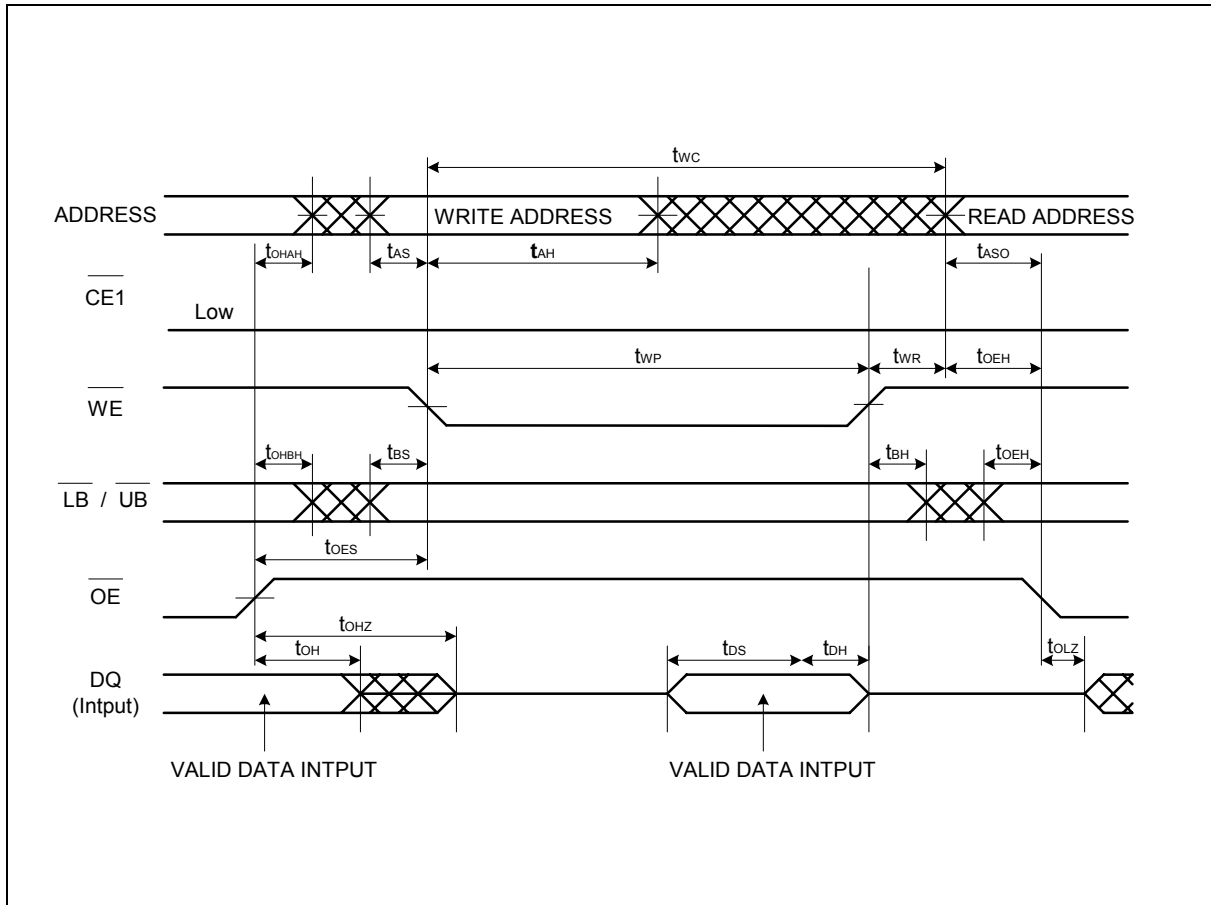


**Note:** The  $t_{oeH}$  is specified from the time satisfied both  $t_{wrc}$  and  $t_{wrc(min)}$ .



Timing Waveforms, Continued

## Read ( $\overline{OE}$ Control) / Write ( $\overline{WE}$ Control) Timing #2-1

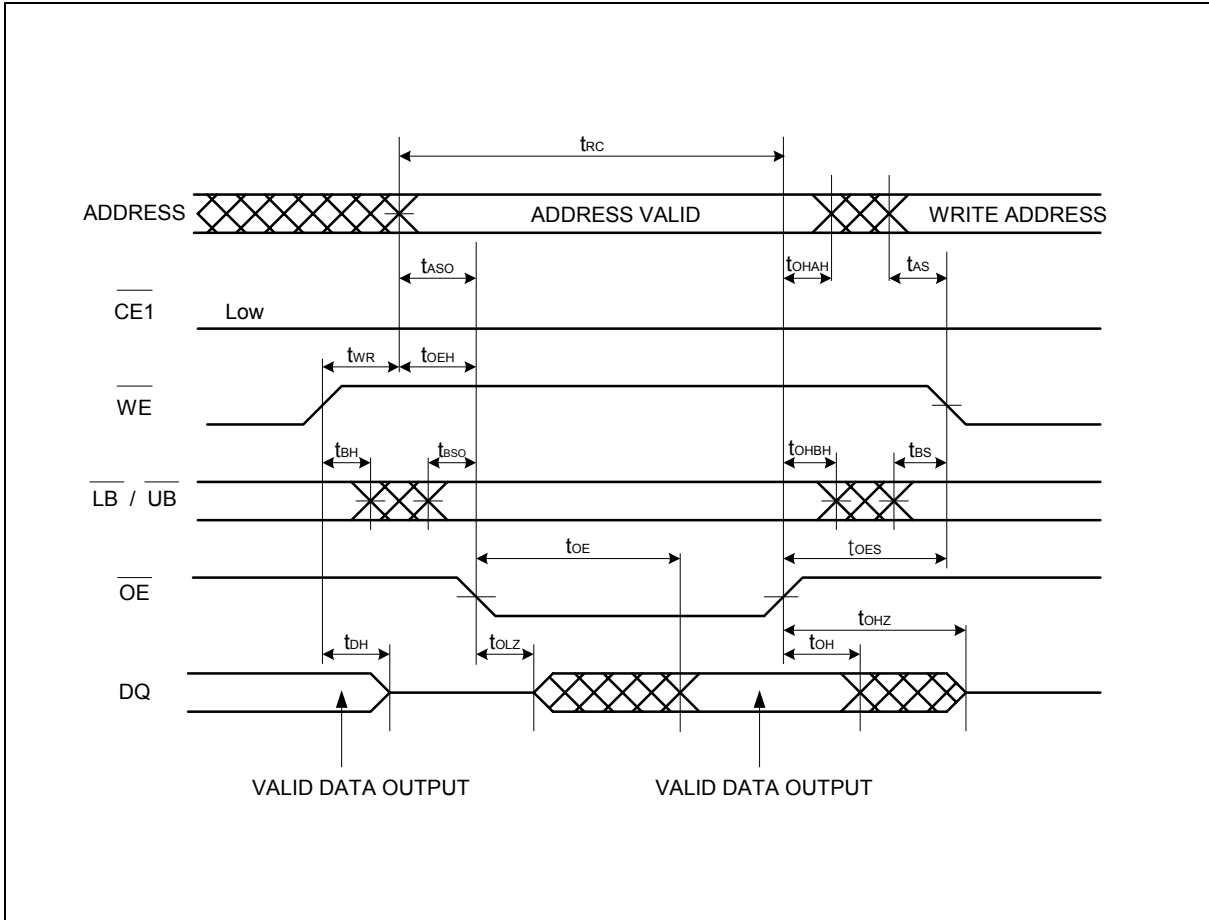


**Note:**  $\overline{CE1}$  can be tied to Low for  $\overline{WE}$  and  $\overline{OE}$  controlled operation.

When  $\overline{CE1}$  is tied to Low, output is exclusively controlled by  $\overline{OE}$ .

Timing Waveforms, Continued

## Read ( $\overline{OE}$ Control) / Write ( $\overline{WE}$ Control) Timing #2-2



**Note:**  $\overline{CE1}$  can be tied to Low for  $\overline{WE}$  and  $\overline{OE}$  controlled operation.

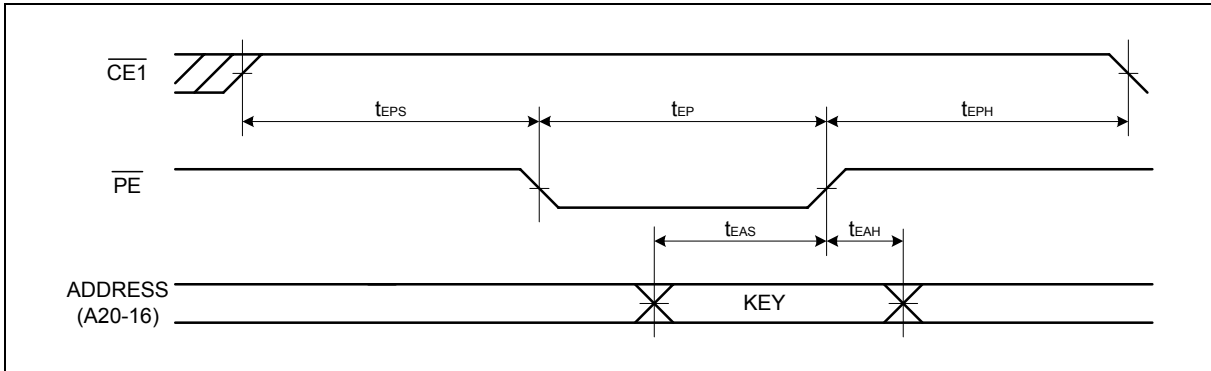
When  $\overline{CE1}$  is tied to Low, output is exclusively controlled by  $\overline{OE}$ .





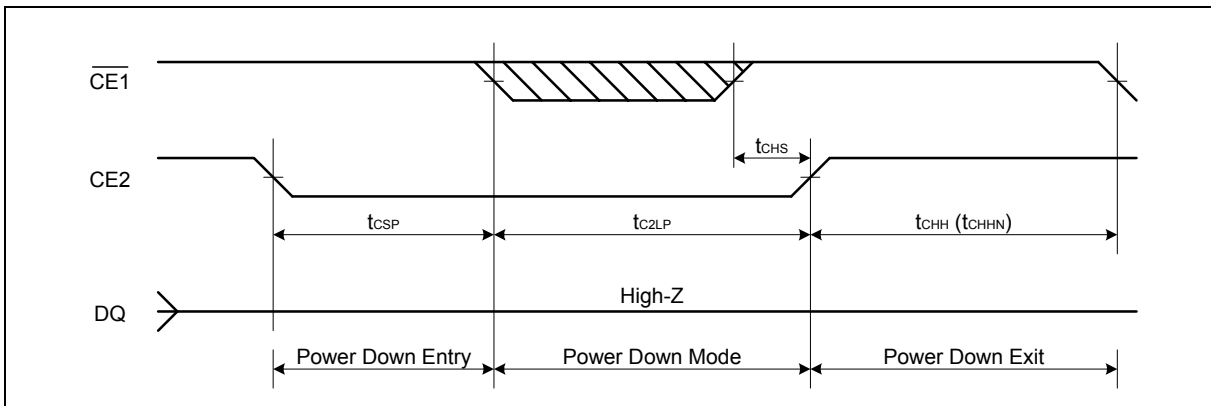
Timing Waveforms, Continued

**Power Down Program Timing**



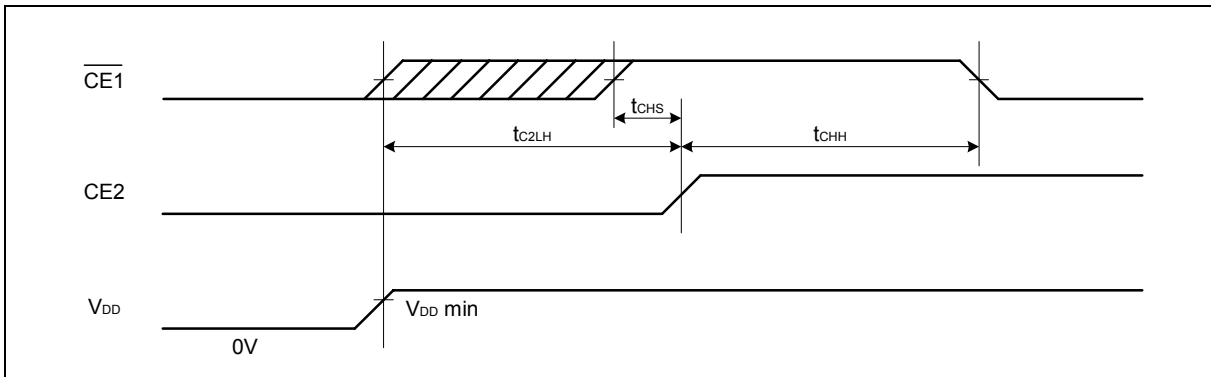
**Note:** CE2 must be High for Power Down Program operation.  
Any other inputs not specified above can be either High or Low.

**Power Down Entry and Exit Timing**



**Note:** This Power Down mode can be also used for Power-up #2 below except that tCHHN can not be used at Power-up timing.

**Power-up Timing #1**

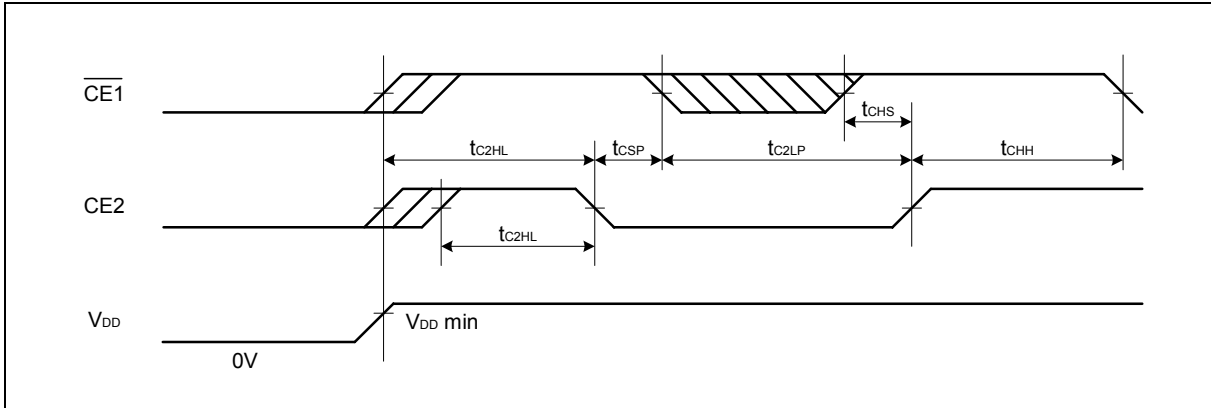


**Note:** The tC2LH specifies after VDD reaches specified minimum level.



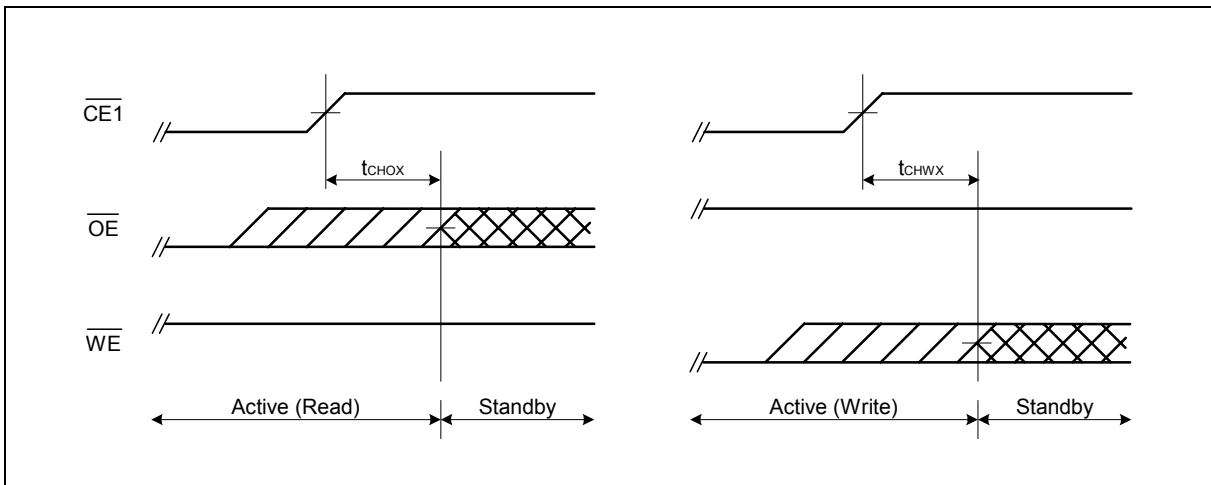
Timing Waveforms, Continued

## Power-up Timing #2



**Note:** The  $t_{C2HL}$  specifies from CE2 low to High transition after  $V_{DD}$  reaches specified minimum level.  
 $\overline{CE1}$  must be brought to High prior to or together with CE2 Low to High transition.

## Standby Entry Timing after Read or Write



**Note:** Both  $t_{CHOX}$  and  $t_{CHWX}$  define the earliest entry timing for Standby mode. If either of timing is not satisfied, it takes  $t_{rc}(\min)$  period from either last address transition of A0, A1 and A2, or  $\overline{CE1}$  Low to High transition.

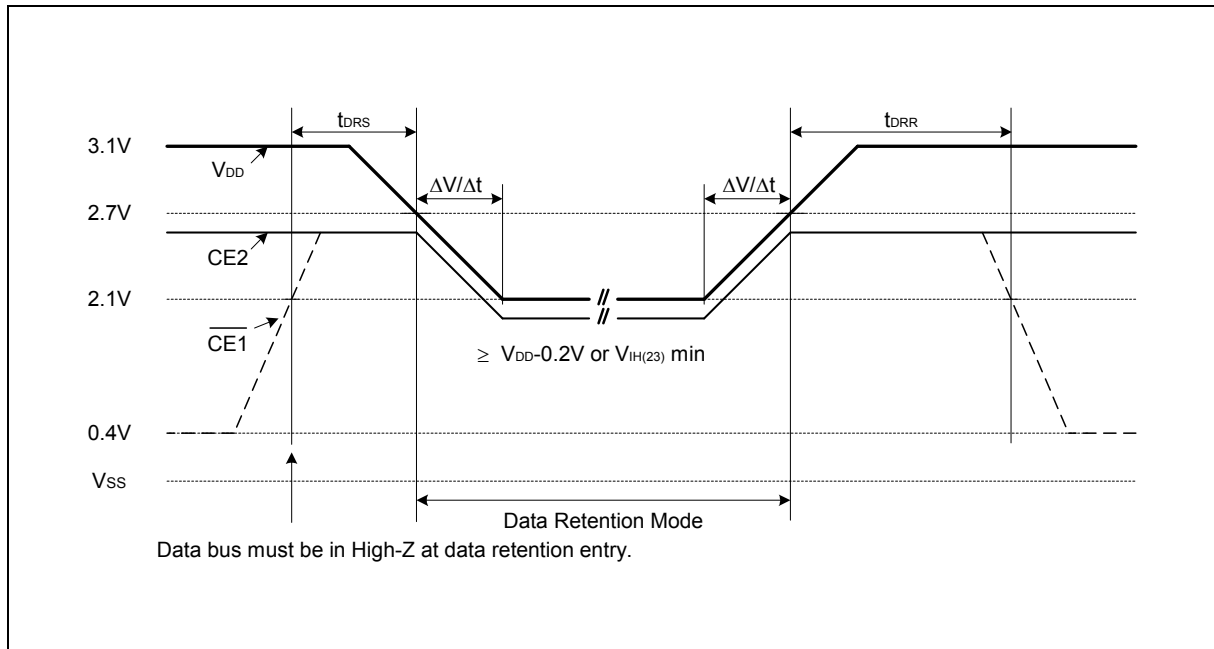


**Data Retention**

**Low V<sub>DD</sub> Characteristics**

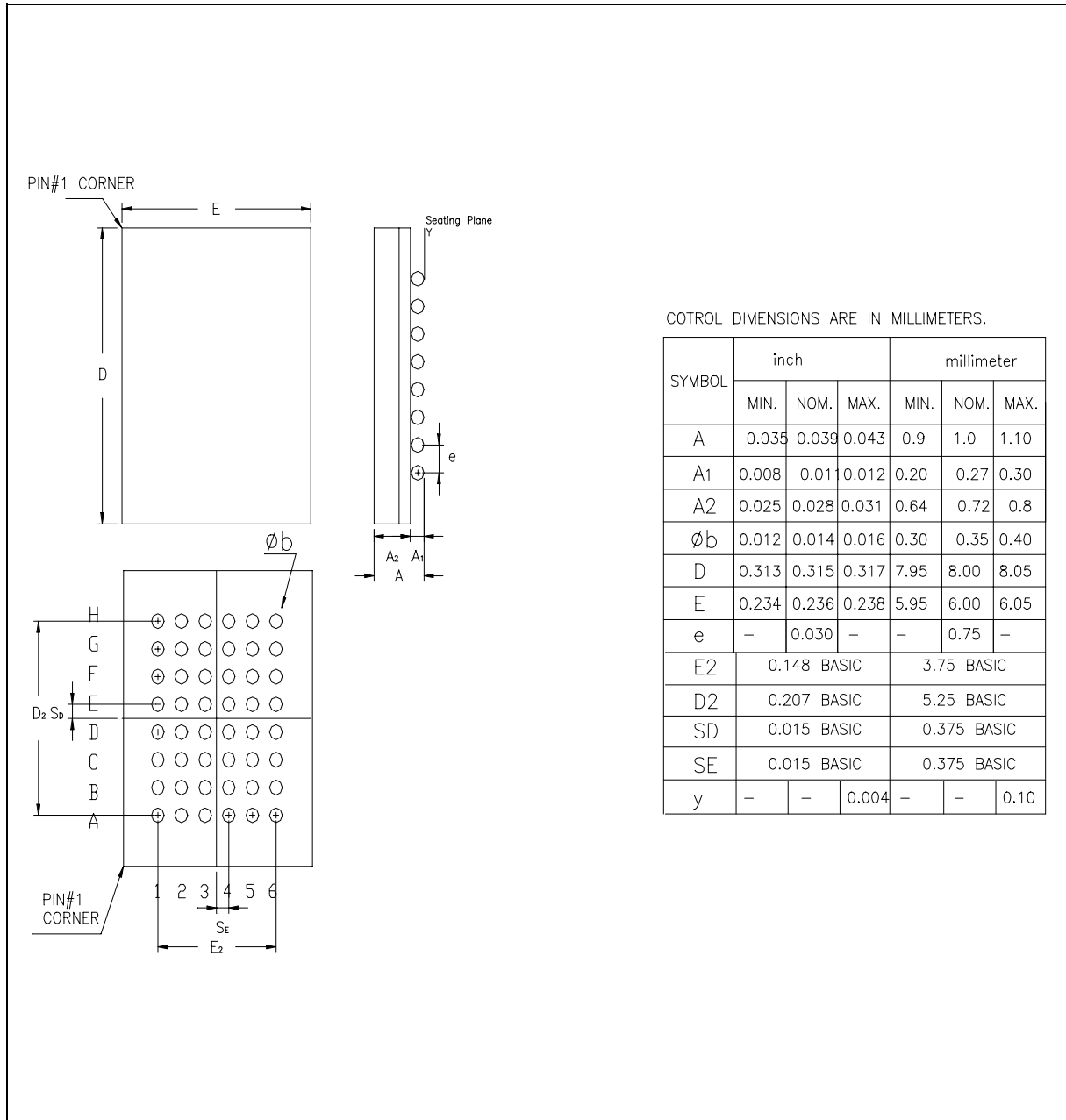
PARAMETER	SYM.	TEST CONDITIONS	MIN.	MAX.	UNIT
V <sub>DD</sub> Data Retention Supply Voltage	VDR	$\overline{CE1} = \overline{CE2} \geq V_{DD} - 0.2V$ or, $\overline{CE1} = \overline{CE2} = V_{IH}$	2.1	3.6	V
V <sub>DD</sub> Data Retention Supply Current	L version	V <sub>DD</sub> = V <sub>DD</sub> (23), V <sub>IN</sub> = V <sub>DD</sub> - 0.2V to V <sub>IH</sub> (23) or V <sub>IL</sub> $\overline{CE1} = \overline{CE2} = V_{IH}(23)$ , I <sub>OUT</sub> = 0 mA	-	5	mA
	L version	V <sub>DD</sub> = V <sub>DD</sub> (23), V <sub>IN</sub> ≤ 0.2V or V <sub>IN</sub> ≥ V <sub>DD</sub> - 0.2V, $\overline{CE1} = \overline{CE2} \geq V_{DD} - 0.2V$ , I <sub>OUT</sub> = 0 mA	-	1.5	
V <sub>DD</sub> Data Retention Supply Current	L version	V <sub>DD</sub> = V <sub>DD</sub> (23), V <sub>IN</sub> ≤ 0.2V or V <sub>IN</sub> ≥ V <sub>DD</sub> - 0.2V, $\overline{CE1} = \overline{CE2} \geq V_{DD} - 0.2V$ , I <sub>OUT</sub> = 0 mA	-	200	μA
			-	100	
Data Retention Setup Time	t <sub>DRS</sub>	V <sub>DD</sub> = V <sub>DD</sub> (27) at data retention entry	0	-	nS
Data Retention Recovery Time	t <sub>DRR</sub>	V <sub>DD</sub> = V <sub>DD</sub> (27) after data retention	200	-	nS
V <sub>DD</sub> Voltage Transition Time	$\Delta V / \Delta t$		0.2	-	V/μS

**Data Retention Timing**



## 10. PACKAGE DIMENSION

TFBGA 48 Balls (6 x 8 mm<sup>2</sup>, pitch 0.75 mm)



COTROL DIMENSIONS ARE IN MILLIMETERS.

SYMBOL	inch			millimeter		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.035	0.039	0.043	0.9	1.0	1.10
A1	0.008	0.01	0.012	0.20	0.27	0.30
A2	0.025	0.028	0.031	0.64	0.72	0.8
$\phi b$	0.012	0.014	0.016	0.30	0.35	0.40
D	0.313	0.315	0.317	7.95	8.00	8.05
E	0.234	0.236	0.238	5.95	6.00	6.05
e	-	0.030	-	-	0.75	-
E2	0.148 BASIC			3.75 BASIC		
D2	0.207 BASIC			5.25 BASIC		
SD	0.015 BASIC			0.375 BASIC		
SE	0.015 BASIC			0.375 BASIC		
y	-	-	0.004	-	-	0.10



## 11. ORDERING INFORMATION

PART NO.	SPEED	OPERATING TEMPERATURE	PACKAGE
W963L6ABN70	70 nS	0 to 70	TFBGA 48, 8 mm x 10 mm, BALL PITCH 0.75 mm
W963L6ABN70E	70 nS	-25 to 85	TFBGA 48, 8 mm x 10 mm, BALL PITCH 0.75 mm
W963L6ABN70I	70 nS	-40 to 85	TFBGA 48, 8 mm x 10 mm, BALL PITCH 0.75 mm
W963L6ABN80	80 nS	0 to 70	TFBGA 48, 8 mm x 10 mm, BALL PITCH 0.75 mm
W963L6ABN80E	80 nS	-25 to 85	TFBGA 48, 8 mm x 10 mm, BALL PITCH 0.75 mm
W963L6ABN80I	80 nS	-40 to 85	TFBGA 48, 8 mm x 10 mm, BALL PITCH 0.75 mm

**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. VERSION HISTORY

VERSION	DATE	PAGE	DESCRIPTION
A1	March 11, 2003	-	Create new document



### 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/>

### 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 America

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

### 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 (Shanghai) Ltd.

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

### 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

*Please note that all data and specifications are subject to change without notice.  
All the trade marks of products and companies mentioned in this data sheet belong to their respective owners.*