

## 16Mb Ultra-Low Power Asynchronous CMOS SRAM

1M x 16 bit

### Overview

The N16T1630C2B is an integrated memory device containing a low power 16 Mbit SRAM built using a self-refresh DRAM array organized as 1,024,576 words by 16 bits. It is designed to be identical in operation and interface to standard 6T SRAMs. The device is designed for low standby and operating current and includes a power-down feature to automatically enter standby mode. The device operates with two chip enable ( $\overline{CE1}$  and  $\overline{CE2}$ ) controls and output enable ( $\overline{OE}$ ) to allow for easy memory expansion. Byte controls ( $\overline{UB}$  and  $\overline{LB}$ ) allow the upper and lower bytes to be accessed independently and can also be used to deselect the device. The N16T1630C2B is optimal for various applications where low-power is critical such as battery backup and hand-held devices. The device can operate over a very wide temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  and is available in JEDEC standard BGA packages compatible with other standard 1Mb x 16 SRAMs.

### Features

- **Single Wide Power Supply Range**  
2.7 to 3.6 Volts
- **Very low standby current**  
100 $\mu\text{A}$  at 3.0V (Max)
- **Very low operating current**  
2.0mA at 3.0V and 1 $\mu\text{s}$  (Typical)
- **Simple memory control**  
Dual Chip Enables ( $\overline{CE1}$  and  $\overline{CE2}$ )  
Byte control for independent byte operation  
Output Enable ( $\overline{OE}$ ) for memory expansion
- **Very fast access time**  
55ns address access option  
35ns  $\overline{OE}$  access time
- **Automatic power down to standby mode**
- **TTL compatible three-state output driver**
- **Green option for BGA package**

### Product Family

Part Number	Package Type	Operating Temperature	Power Supply (Vcc)	Speed	Standby Current ( $I_{\text{SB}}$ ), Max @ 3.0V	Operating Current ( $I_{\text{CC}}$ ), Max
N16T1630C2BZ	48 - BGA	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$	2.7V - 3.6V	70ns	100 $\mu\text{A}$	3 mA @ 1MHz
N16T1630C2BZZ	Green 48 - BGA			55ns		

### Pin Configuration (Top View)

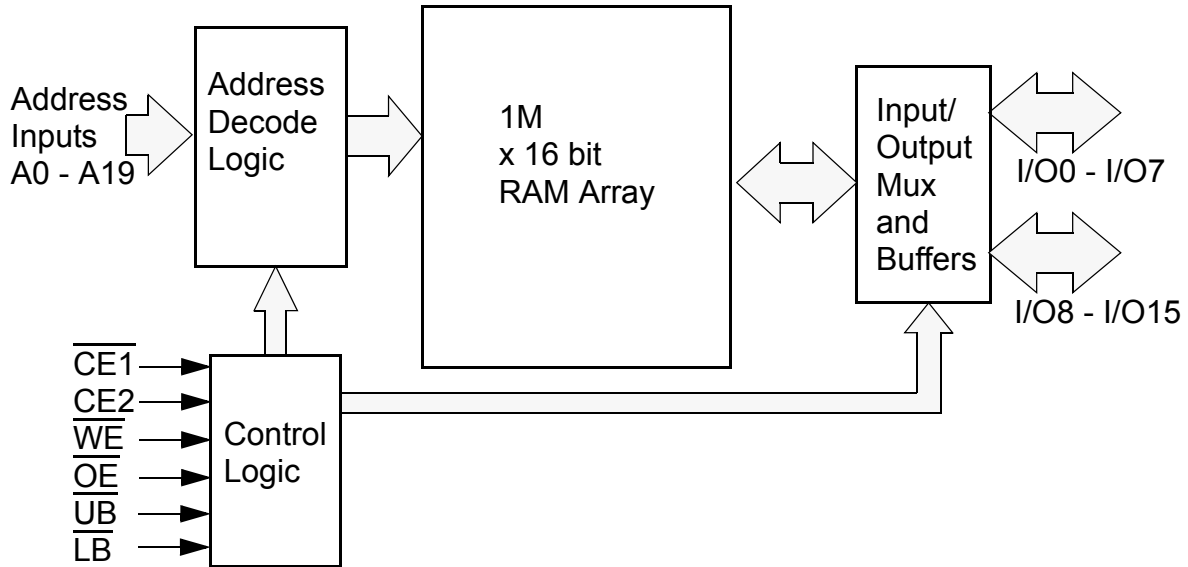
	1	2	3	4	5	6
A	$\overline{LB}$	$\overline{OE}$	$A_0$	$A_1$	$A_2$	$\overline{CE2}$
B	$I/O_8$	$\overline{UB}$	$A_3$	$A_4$	$\overline{CE1}$	$I/O_0$
C	$I/O_9$	$I/O_{10}$	$A_5$	$A_6$	$I/O_1$	$I/O_2$
D	$V_{\text{SS}}$	$I/O_{11}$	$A_{17}$	$A_7$	$I/O_3$	$V_{\text{CC}}$
E	$V_{\text{CC}}$	$I/O_{12}$	NC	$A_{16}$	$I/O_4$	$V_{\text{SS}}$
F	$I/O_{14}$	$I/O_{13}$	$A_{14}$	$A_{15}$	$I/O_5$	$I/O_6$
G	$I/O_{15}$	$A_{19}$	$A_{12}$	$A_{13}$	$\overline{WE}$	$I/O_7$
H	$A_{18}$	$A_8$	$A_9$	$A_{10}$	$A_{11}$	NC

48 Ball BGA  
6 x 8 mm

### Pin Description

Pin Name	Pin Function
$A_0$ - $A_{19}$	Address Inputs
$\overline{WE}$	Write Enable Input
$\overline{CE1}$ , $\overline{CE2}$	Chip Enable Input
$\overline{OE}$	Output Enable Input
$\overline{LB}$	Lower Byte Enable Input
$\overline{UB}$	Upper Byte Enable Input
$I/O_0$ - $I/O_{15}$	Data Inputs/Outputs
$V_{\text{CC}}$	Power
$V_{\text{SS}}$	Ground
NC	Not Connected

## Functional Block Diagram



## Functional Description

$\overline{CE1}$	$CE2$	$\overline{WE}$	$\overline{OE}$	$\overline{UB}$	$\overline{LB}$	$I/O_0 - I/O_{15}^1$	MODE	POWER
H	X	X	X	X	X	High Z	Standby <sup>2</sup>	Standby
X	L	X	X	X	X	High Z	Standby <sup>2</sup>	Standby
L	H	X	X	H	H	High Z	Standby	Standby
L	H	L	X <sup>3</sup>	L <sup>1</sup>	L <sup>1</sup>	Data In	Write	Active
L	H	H	L	L <sup>1</sup>	L <sup>1</sup>	Data Out	Read	Active
L	H	H	H	L <sup>1</sup>	L <sup>1</sup>	High Z	Active	Active

1. When  $\overline{UB}$  and  $\overline{LB}$  are in select mode (low),  $I/O_0 - I/O_{15}$  are affected as shown. When  $\overline{LB}$  only is in the select mode only  $I/O_0 - I/O_7$  are affected as shown. When  $\overline{UB}$  is in the select mode only  $I/O_8 - I/O_{15}$  are affected as shown.

2. When the device is in standby mode, control inputs ( $\overline{WE}$ ,  $\overline{OE}$ ,  $\overline{UB}$ , and  $\overline{LB}$ ), address inputs and data input/outputs are internally isolated from any external influence and disabled from exerting any influence externally.

3. When  $\overline{WE}$  is invoked, the  $\overline{OE}$  input is internally disabled and has no effect on the circuit.

## Capacitance<sup>1</sup>

Item	Symbol	Test Condition	Min	Max	Unit
Input Capacitance	$C_{IN}$	$V_{IN} = 0V, f = 1 \text{ MHz}, T_A = 25^\circ\text{C}$		8	pF
I/O Capacitance	$C_{I/O}$	$V_{IN} = 0V, f = 1 \text{ MHz}, T_A = 25^\circ\text{C}$		8	pF

1. These parameters are verified in device characterization and are not 100% tested

**Absolute Maximum Ratings<sup>1</sup>**

Item	Symbol	Rating	Unit
Voltage on any pin relative to $V_{SS}$	$V_{IN,OUT}$	-0.3 to $V_{CC}+0.3$	V
Voltage on $V_{CC}$ Supply Relative to $V_{SS}$	$V_{CC}$	-0.3 to 4.5	V
Power Dissipation	$P_D$	500	mW
Storage Temperature	$T_{STG}$	-40 to 125	°C
Operating Temperature	$T_A$	-40 to +85	°C
Soldering Temperature and Time	$T_{SOLDER}$	260°C, 10sec	°C

1. Stresses greater than those listed above may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operating section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**Operating Characteristics (Over Specified Temperature Range)**

Item	Symbol	Test Conditions	Min.	Typ <sup>1</sup>	Max	Unit
Supply Voltage	$V_{CC}$		2.7	3.0	3.6	V
Input High Voltage	$V_{IH}$		2.2		$V_{CC}+0.3$	V
Input Low Voltage	$V_{IL}$		-0.3		0.6	V
Output High Voltage	$V_{OH}$	$I_{OH} = -0.2mA$	$V_{CC}-0.2$			V
Output Low Voltage	$V_{OL}$	$I_{OL} = 0.2mA$			0.2	V
Input Leakage Current	$I_{LI}$	$V_{IN} = 0$ to $V_{CC}$			0.5	μA
Output Leakage Current	$I_{LO}$	$\overline{OE} = V_{IH}$ or Chip Disabled			0.5	μA
Read/Write Operating Supply Current @ 1 μs Cycle Time <sup>2</sup>	$I_{CC1}$	$V_{CC}=3.6$ V, $V_{IN}=V_{IH}$ or $V_{IL}$ Chip Enabled, $I_{OUT} = 0$			5.0	mA
Read/Write Operating Supply Current @ 70 ns Cycle Time <sup>2</sup>	$I_{CC2}$	$V_{CC}=3.6$ V, $V_{IN}=V_{IH}$ or $V_{IL}$ Chip Enabled, $I_{OUT} = 0$			25.0	mA
Maximum Standby Current	$I_{SB1}$	$V_{IN} = V_{CC}$ or 0V Chip Disabled $t_A = 85^\circ C$ , $V_{CC} = 3.0$ V			100.0	μA

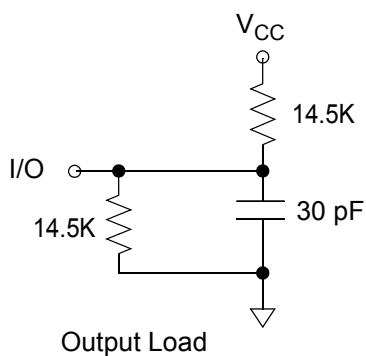
1. Typical values are measured at  $V_{CC}=V_{CC}$  Typ.,  $T_A=25^\circ C$  and not 100% tested.

2. This parameter is specified with the outputs disabled to avoid external loading effects. The user must add current required to drive output capacitance expected in the actual system.

## Timing Test Conditions

Item	
Input Pulse Level	$0.1V_{CC}$ to $0.9V_{CC}$
Input Rise and Fall Time	5ns
Input and Output Timing Reference Levels	$0.5V_{CC}$
Operating Temperature	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$

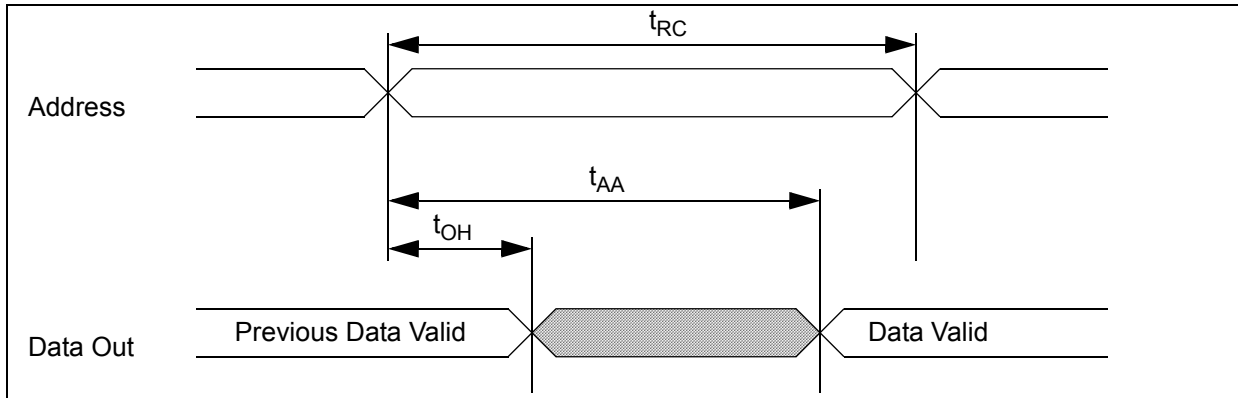
## Output Load Circuit



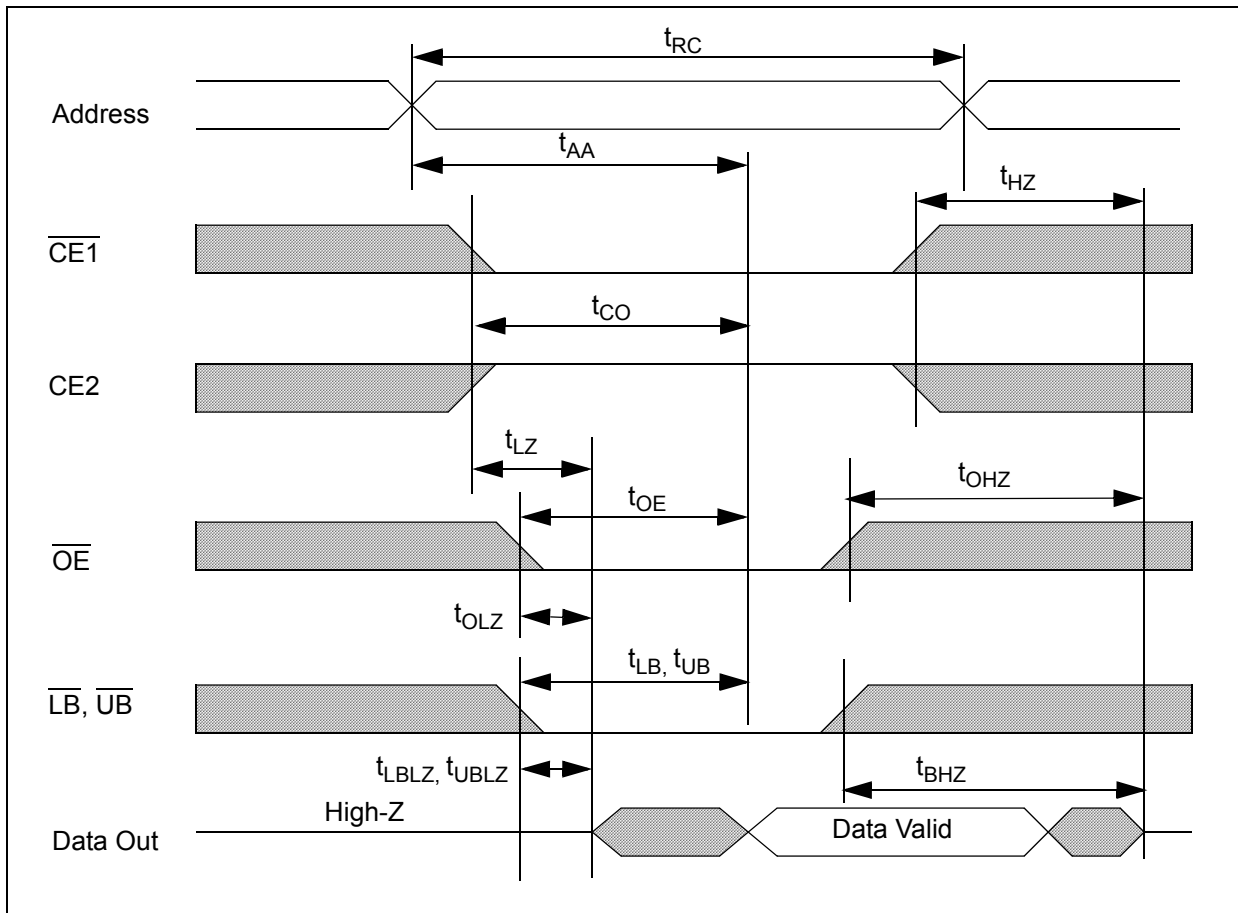
## Timing

Item	Symbol	-55		-70		Units
		Min.	Max.	Min.	Max.	
Read Cycle Time	$t_{RC}$	55		70		ns
Address Access Time	$t_{AA}$		55		70	ns
Chip Enable to Valid Output	$t_{CO}$		55		70	ns
Output Enable to Valid Output	$t_{OE}$		30		35	ns
Byte Select to Valid Output	$t_{LB}, t_{UB}$		55		70	ns
Chip Enable to Low-Z output	$t_{LZ}$	5		5		ns
Output Enable to Low-Z Output	$t_{OLZ}$	5		5		ns
Byte Select to Low-Z Output	$t_{BLZ}$	5		5		ns
Chip Disable to High-Z Output	$t_{HZ}$	0	25	0	25	ns
Output Disable to High-Z Output	$t_{OHZ}$	0	25	0	25	ns
Byte Select Disable to High-Z Output	$t_{BHZ}$	0	25	0	25	ns
Output Hold from Address Change	$t_{OH}$	10		10		ns
Write Cycle Time	$t_{WC}$	55		70		ns
Chip Enable to End of Write	$t_{CW}$	50		55		ns
Address Valid to End of Write	$t_{AW}$	50		55		ns
Byte Select to End of Write	$t_{BW}$	50		55		ns
Write Pulse Width	$t_{WP}$	50		55		ns
Address Setup Time	$t_{AS}$	0		0		ns
Write Recovery Time	$t_{WR}$	0		0		ns
Write to High-Z Output	$t_{WHZ}$		25		25	ns
Data to Write Time Overlap	$t_{DW}$	25		25		ns
Data Hold from Write Time	$t_{DH}$	0		0		ns
End Write to Low-Z Output	$t_{OW}$	5		5		ns

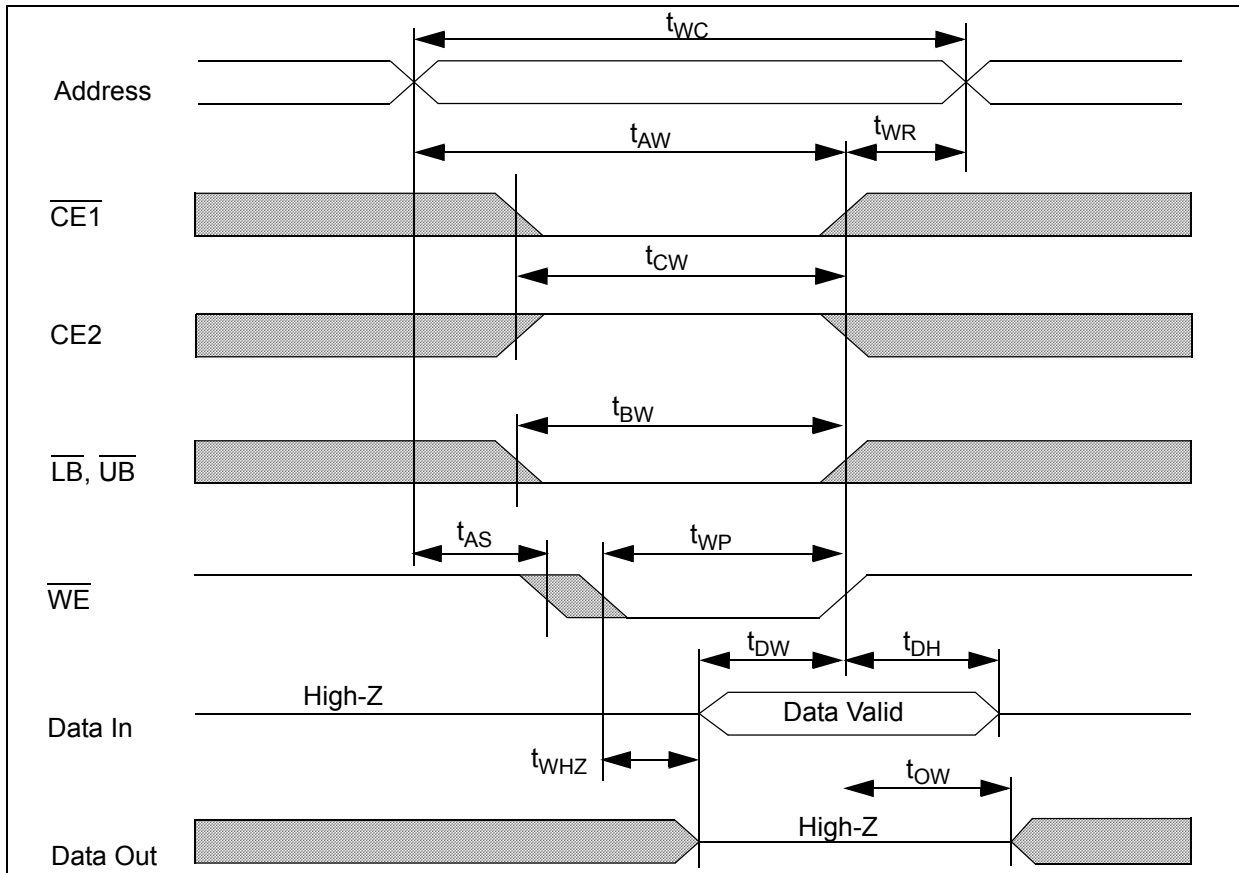
## Timing of Read Cycle ( $\overline{CE1} = \overline{OE} = V_{IL}, \overline{WE} = CE2 = V_{IH}$ )



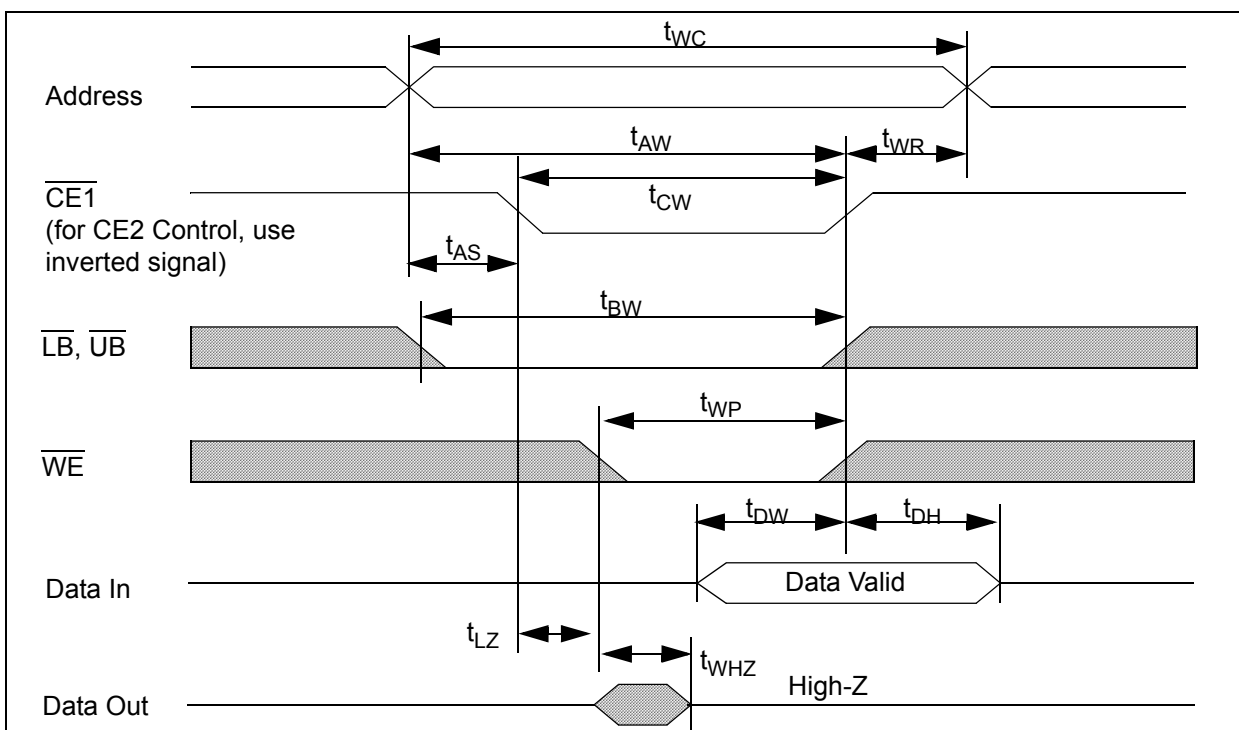
## Timing Waveform of Read Cycle ( $\overline{WE} = V_{IH}$ )



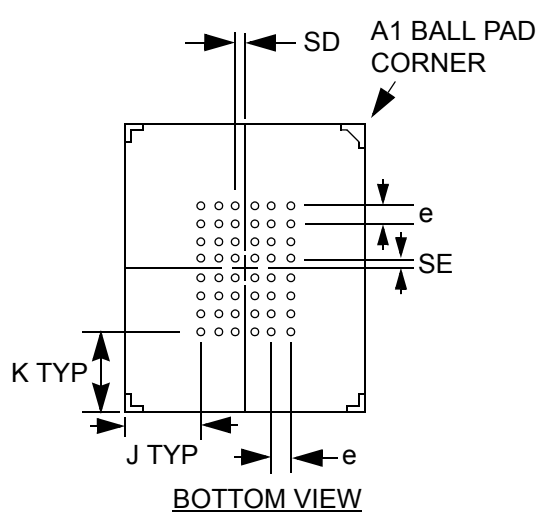
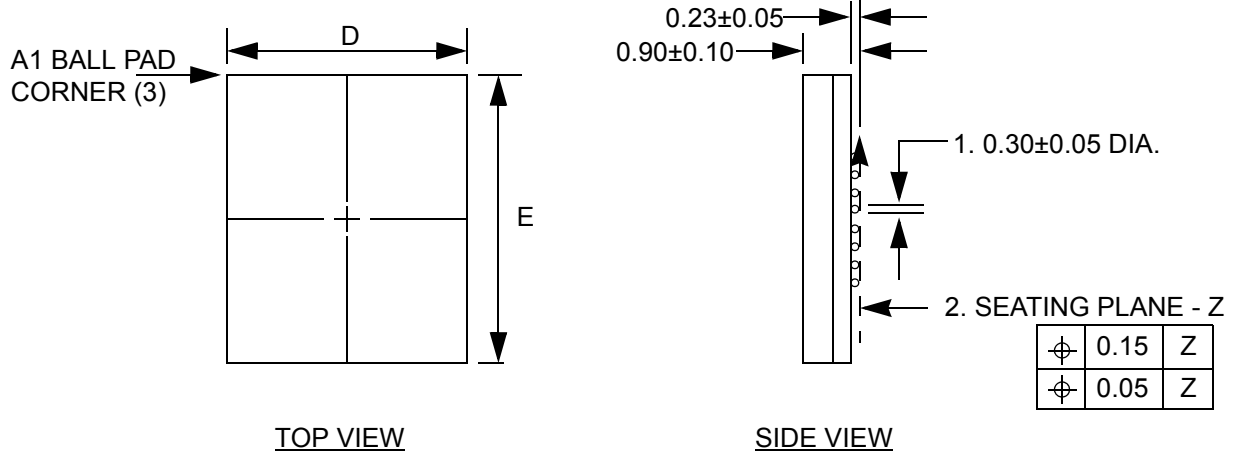
## Timing Waveform of Write Cycle ( $\overline{WE}$ control)



## Timing Waveform of Write Cycle ( $\overline{CE1}$ Control)



## Ball Grid Array Package



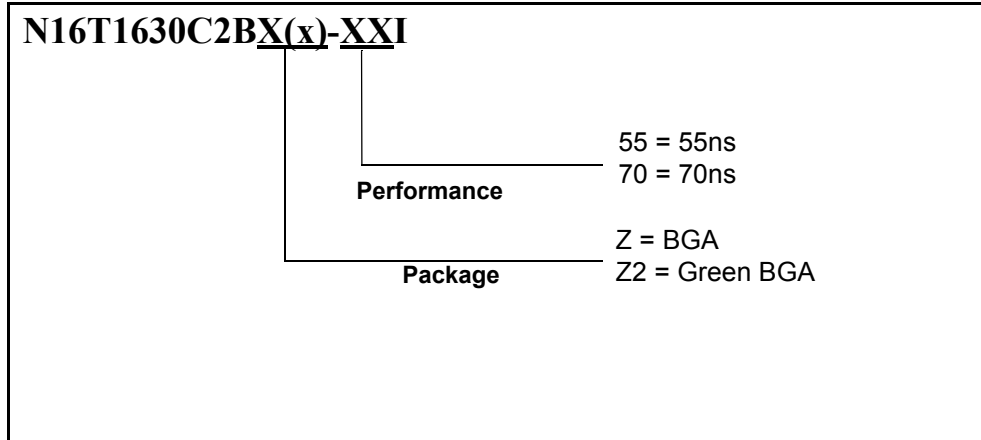
1. DIMENSION IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER. PARALLEL TO PRIMARY Z.
2. PRIMARY DATUM Z AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
3. A1 BALL PAD CORNER I.D. TO BE MARKED BY INK.

## Dimensions (mm)

D	E	e = 0.75				BALL MATRIX TYPE
		SD	SE	J	K	
6±0.10	8±0.10	0.375	0.375	1.125	1.375	FULL



## Ordering Information



## Revision History

Revision	Date	Change Description
A	January 2003	Initial Preliminary Release
B	August 2003	Corrected typo for Ioh and Iol Increased Isb to 100uA at 3V
C	September 2003	Add test conditions
D	March 2004	Remove TSOP Package
E	August 2004	Changed ball(E3) from Vss to NC
F	January 2005	Added Green package offering

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