

4Mb Ultra-Low Power Asynchronous CMOS SRAM

256K × 16 bit

Overview

The N04L163WC1C is an integrated memory device containing a 4 Mbit Static Random Access Memory organized as 262,144 words by 16 bits. The device is designed and fabricated using NanoAmp's advanced CMOS technology to provide both high-speed performance and ultra-low power. The device operates with a single chip enable (\overline{CE}) control 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. The N04L163WC1C 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°C to +85°C and is available in JEDEC standard packages compatible with other standard 256Kb x 16 SRAMs.

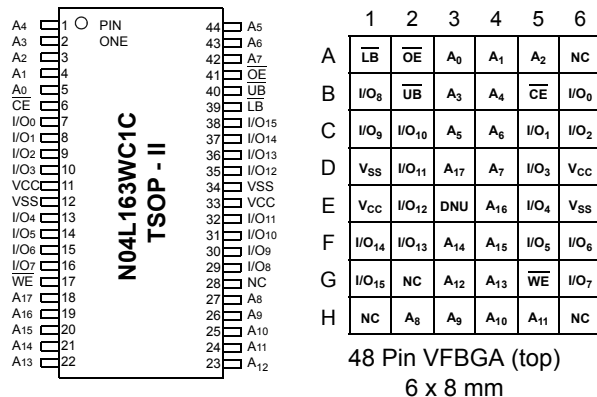
Features

- **Single Wide Power Supply Range**
2.2 to 3.6 Volts
- **Very low standby current**
2.0µA at 3.0V (Typical)
- **Very low operating current**
1.5mA at 3.0V and 1µs (Typical)
- **Simple memory control**
Single Chip Enable (\overline{CE})
Byte control for independent byte operation
Output Enable (\overline{OE}) for memory expansion
- **Low voltage data retention**
V_{CC} = 1.5V
- **Very fast output enable access time**
25ns \overline{OE} access time
- **Automatic power down to standby mode**
- **TTL compatible three-state output driver**
- **Compact space saving BGA package available**
- **Ultra Low Power Sort Available**

Product Family

Part Number	Package Type	Operating Temperature	Power Supply (V _{CC})	Speed Options	Standby Current (I _{SB}), Typical	Operating Current (I _{CC}), Typical
N04L163WC1CZ1	VFBGA Pb-Free	-40°C to +85°C	2.2V - 3.6V	55ns	2 µA	1.5 mA @ 1MHz
N04L163WC1CT1	44-TSOP II Pb-Free					

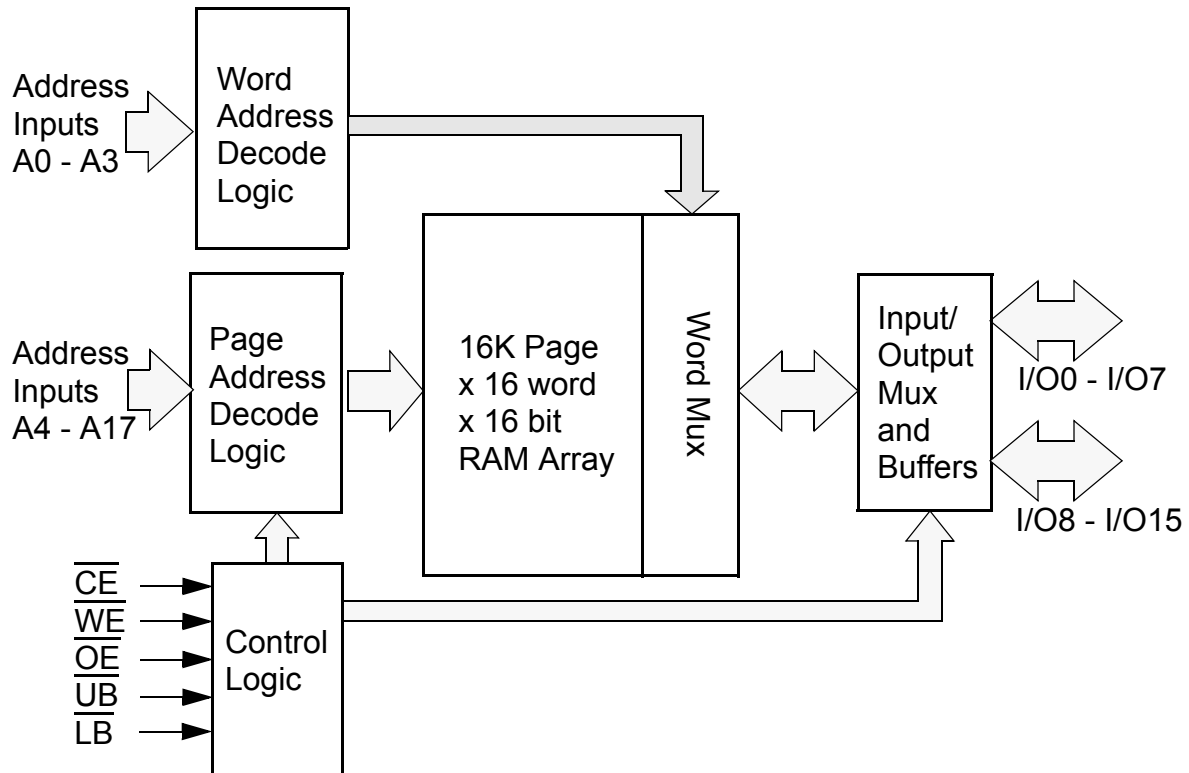
Pin Configurations



Pin Descriptions

Pin Name	Pin Function
A ₀ -A ₁₇	Address Inputs
\overline{WE}	Write Enable Input
\overline{CE}	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 _{CC}	Power
V _{SS}	Ground
NC	Not Connected
DNU	Do Not Use

Functional Block Diagram



Functional Description

\overline{CE}	\overline{WE}	\overline{OE}	\overline{UB}	\overline{LB}	I/O ₀ - I/O ₁₅ ¹	MODE	POWER
H	X	X	X	X	High Z	Standby ²	Standby
X	X	X	H	H	High Z	Standby ²	Standby
L	L	X ³	L ¹	L ¹	Data In	Write ³	Active
L	H	L	L ¹	L ¹	Data Out	Read	Active
L	H	H	L ¹	L ¹	High Z	Active	Active

- When \overline{UB} and \overline{LB} are in select mode (low), I/O₀ - I/O₁₅ are affected as shown. When \overline{LB} only is in the select mode only I/O₀ - I/O₇ are affected as shown. When \overline{UB} is in the select mode only I/O₈ - I/O₁₅ are affected as shown.
- 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.
- When \overline{WE} is invoked, the \overline{OE} input is internally disabled and has no effect on the circuit.

Capacitance¹

Item	Symbol	Test Condition	Min	Max	Unit
Input Capacitance	C _{IN}	V _{IN} = 0V, f = 1 MHz, T _A = 25°C		10	pF
I/O Capacitance	C _{I/O}	V _{IN} = 0V, f = 1 MHz, T _A = 25°C		10	pF

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

Absolute Maximum Ratings¹

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}	-65 to 150	°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 ¹	Max	Unit	
Supply Voltage	V _{CC}		2.2	3.0	3.6	V	
Data Retention Voltage	V _{DR}	Chip Disabled	1.5			V	
Input High Voltage	V _{IH}	V _{CC} = 2.2V to 2.7V	1.8		V _{CC} +0.3	V	
		V _{CC} = 2.7V to 3.6V	2.2		V _{CC} +0.3		
Input Low Voltage	V _{IL}	V _{CC} = 2.2V to 2.7V	-0.3		0.6	V	
		V _{CC} = 2.7V to 3.6V	-0.3		0.8		
Output High Voltage	V _{OH}	I _{OH} = -0.1mA, V _{CC} = 2.20V	2.0			V	
		I _{OH} = -1.0mA, V _{CC} = 2.70V	2.4				
Output Low Voltage	V _{OL}	I _{OL} = 0.1mA, V _{CC} = 2.20V			0.4	V	
		I _{OL} = 2.1mA, V _{CC} = 2.70V			0.4		
Input Leakage Current	I _{LI}	V _{IN} = 0 to V _{CC}	-1		1	μA	
Output Leakage Current	I _{LO}	\overline{OE} = V _{IH} or Chip Disabled V _{OUT} = 0 to V _{CC}	-1		1	μA	
Read/Write Operating Supply Current @ 1 μs Cycle Time ²	I _{CC1}	V _{CC} =3.6 V, V _{IN} =V _{IH} or V _{IL} Chip Enabled, I _{OUT} = 0			1.5	3.0	mA
			-L		1.5	3.0	
Read/Write Operating Supply Current @ f _{max}	I _{CC2}	V _{CC} =3.6 V, V _{IN} =V _{IH} or V _{IL} Chip Enabled, I _{OUT} = 0			8	15.0	mA
			-L		8	10.0	
Maximum Standby Current	I _{SB1}	V _{IN} = V _{CC} or 0V Chip Disabled t _A = 85°C, V _{CC} = 3.6 V			2.0	12	μA
			-L		2.0	8	
Maximum Data Retention Current	I _{DR}	V _{CC} = 1.5V, CE ≥ V _{CC} - 0.2V, V _{IN} ≥ V _{CC} - 0.2V or V _{IN} ≤ 0.2V				9	μA
			-L			6	

1. Typical values are measured at V_{CC}=V_{CC} Typ., T_A=25°C and are 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 0.9 V _{CC}
Input Rise and Fall Time	1V/ns
Input and Output Timing Reference Levels	0.5 V _{CC}
Output Load	CL = 50pF
Operating Temperature	-40 to +85 °C

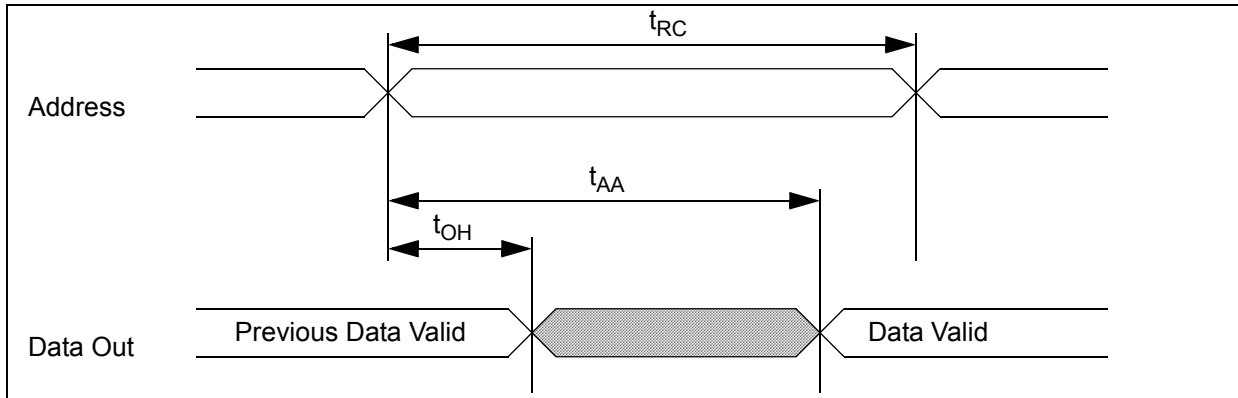
Timing

Item	Symbol	-55		Units
		Min.	Max.	
Read Cycle Time	t _{RC}	55		ns
Address Access Time	t _{AA}		55	ns
Chip Enable to Valid Output	t _{CO}		55	ns
Output Enable to Valid Output	t _{OE}		25	ns
Byte Select to Valid Output	t _{LB} , t _{UB}		55	ns
Chip Enable to Low-Z output	t _{LZ}	10		ns
Output Enable to Low-Z Output	t _{OLZ}	5		ns
Byte Select to Low-Z Output	t _{LBZ} , t _{UBZ}	10		ns
Chip Disable to High-Z Output	t _{HZ}	0	20	ns
Output Disable to High-Z Output	t _{OHZ}	0	20	ns
Byte Select Disable to High-Z Output	t _{LBHZ} , t _{UBHZ}	0	20	ns
Output Hold from Address Change	t _{OH}	10		ns
Write Cycle Time	t _{WC}	55		ns
Chip Enable to End of Write	t _{CW}	40		ns
Address Valid to End of Write	t _{AW}	40		ns
Byte Select to End of Write	t _{LBW} , t _{UBW}	40		ns
Write Pulse Width	t _{WP}	40		ns
Address Setup Time	t _{AS}	0		ns
Write Recovery Time	t _{WR}	0		ns
Write to High-Z Output	t _{WHZ}		20	ns
Data to Write Time Overlap	t _{DW}	25		ns
Data Hold from Write Time	t _{DH}	0		ns
End Write to Low-Z Output	t _{OW}	10		ns

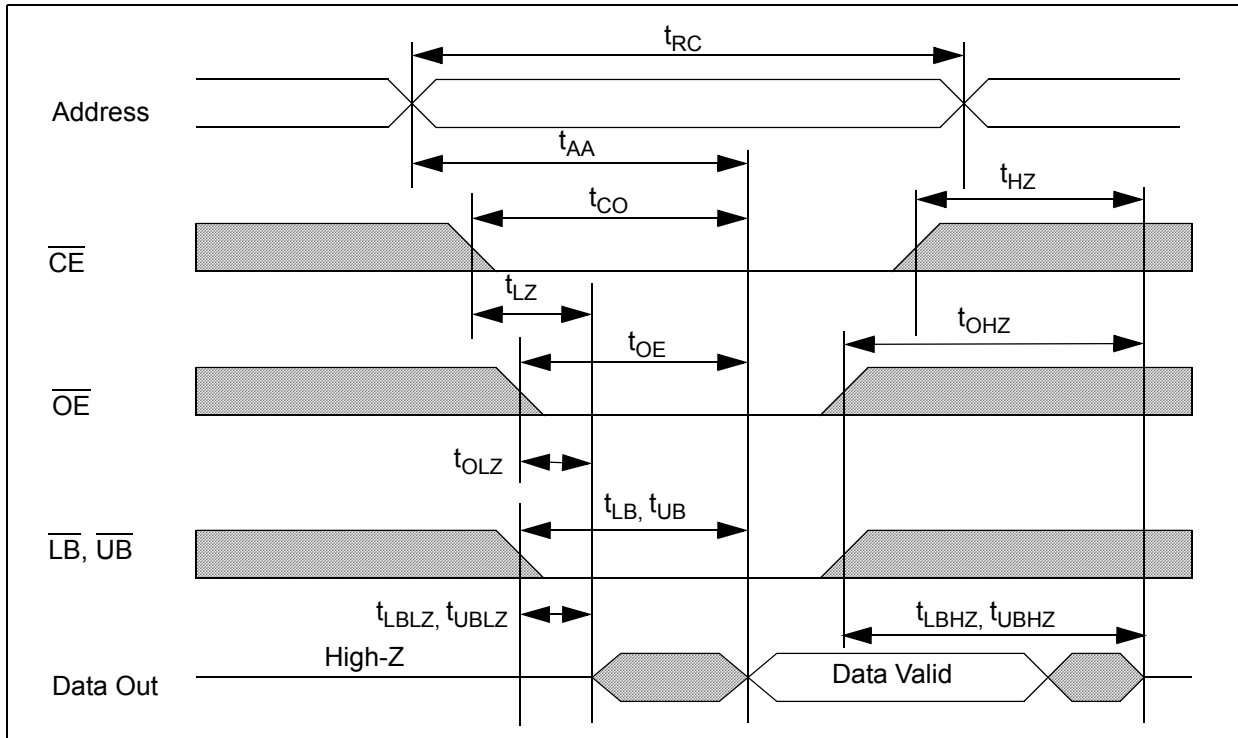
Note:

1. Full device AC operation assumes a 100us ramp time from 0 to V_{CC}(min) and 200us wait time after V_{CC} stabilization.
2. Full device operation requires linear V_{CC} ramp from V_{DR} to V_{CC}(min) ≥ 100us or stable at V_{CC}(min) ≥ 100us.

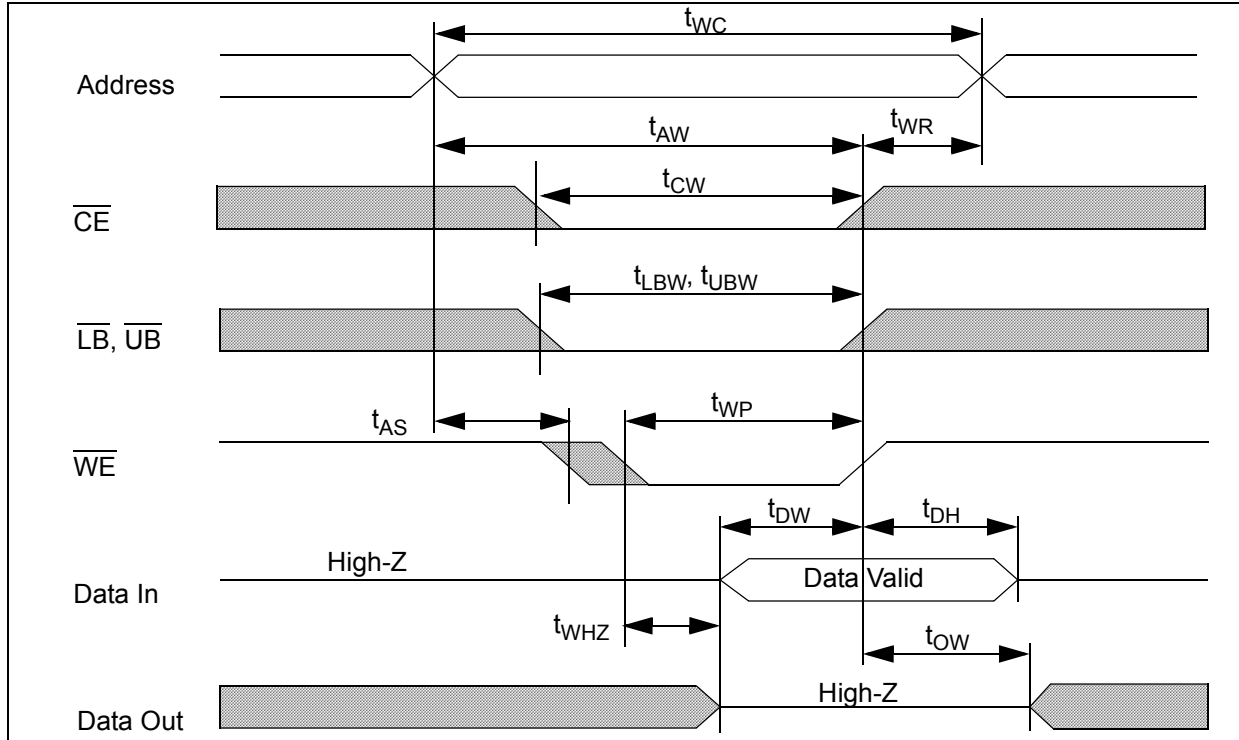
Timing of Read Cycle ($\overline{CE} = \overline{OE} = V_{IL}, \overline{WE} = V_{IH}$)



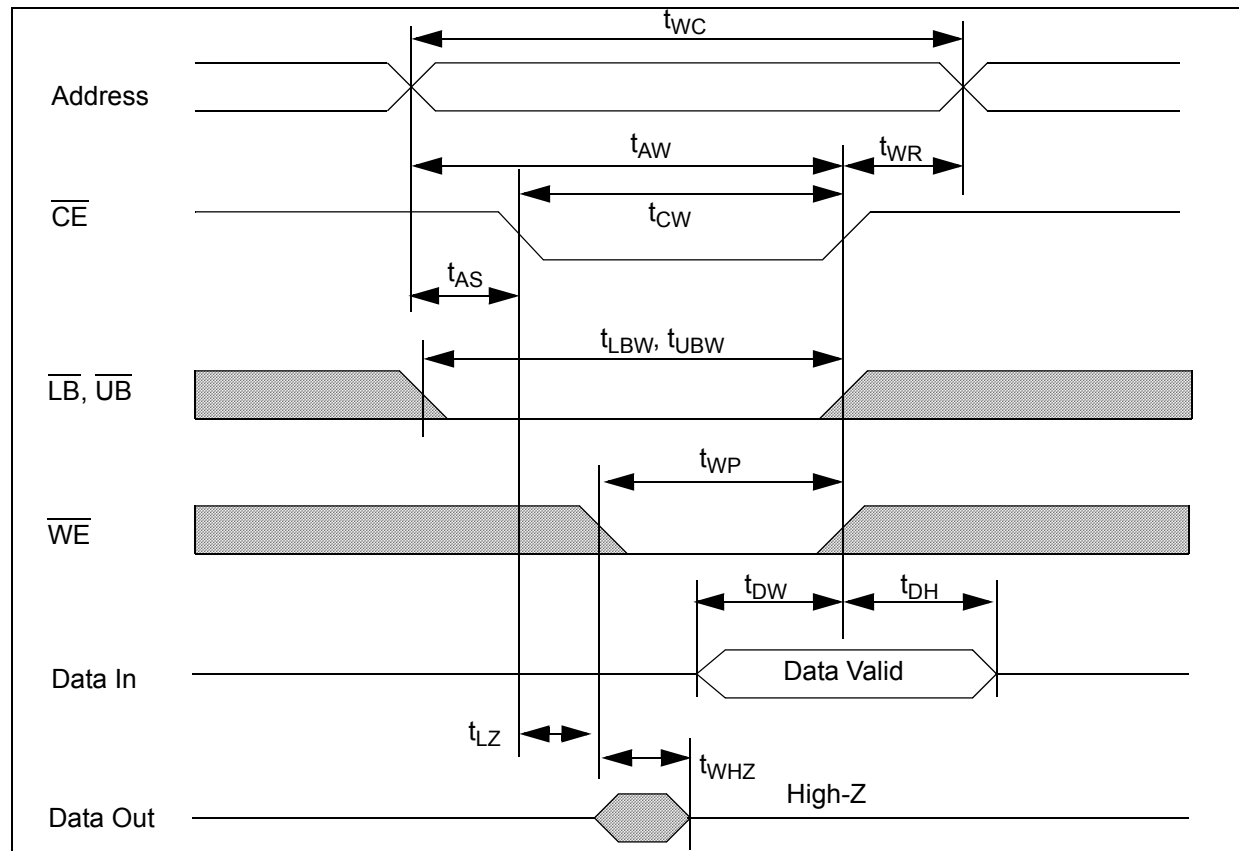
Timing Waveform of Read Cycle ($\overline{WE} = V_{IH}$)



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



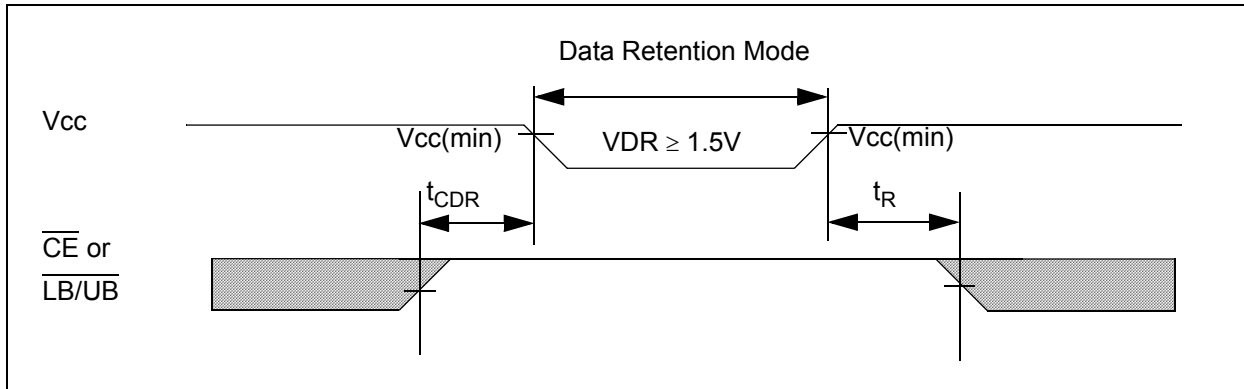
Timing Waveform of Write Cycle (\overline{CE} Control)



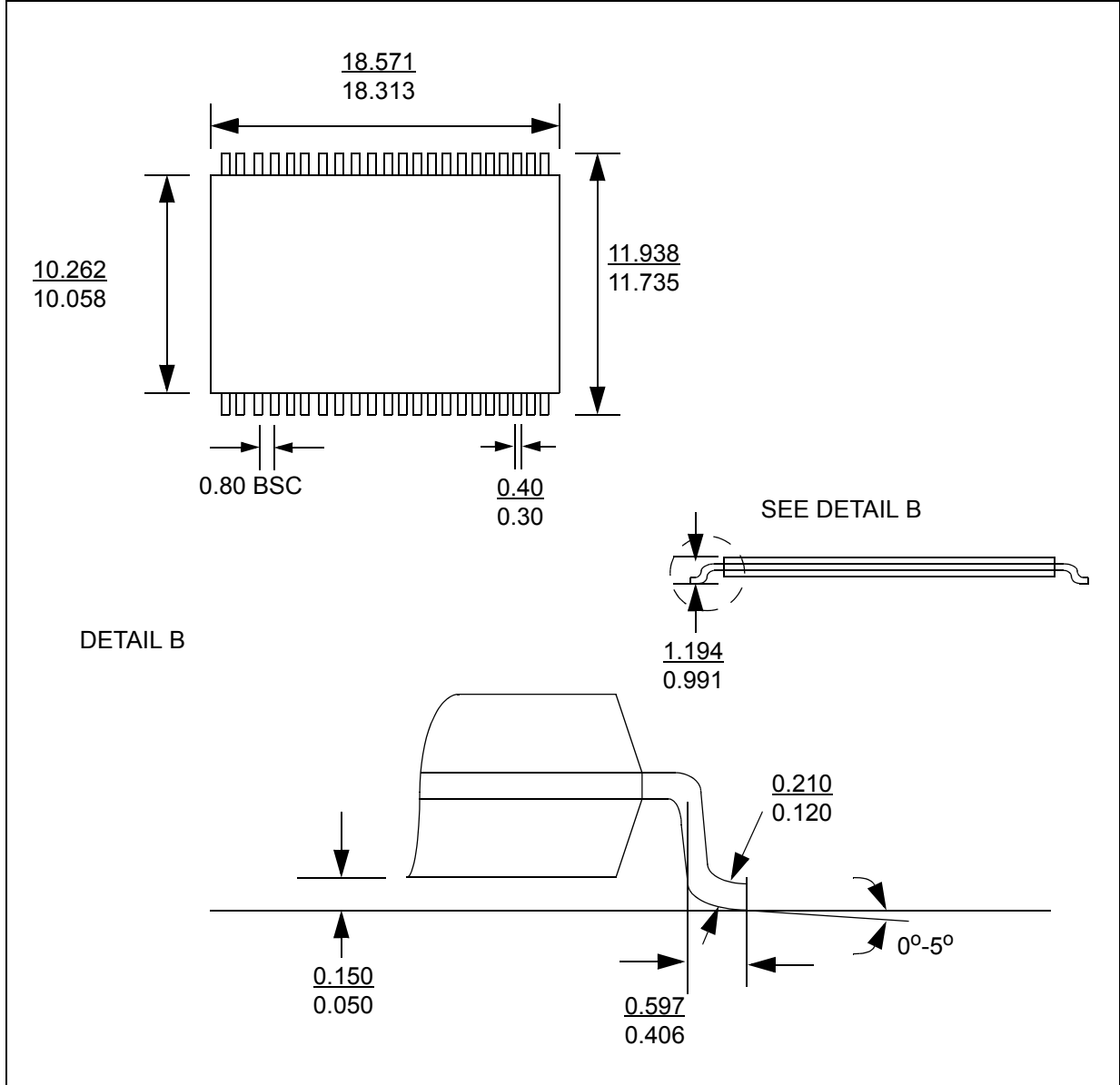
Data Retention Characteristics

Parameter	Description	Condition	Min	Typ	Max	Unit
V_{DR}	Vcc for Data Retention		1.5			V
I_{CCDR}	Data Retention Current	$V_{CC} = 1.5V, CE \geq V_{CC} - 0.2V,$ $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$			9	μA
		-L			6	
t_{CDR}	Chip Deselect to Data Retention Time		0			ns
t_R	Operation Recovery Time		t_{RC}			ns

Data Retention Waveform



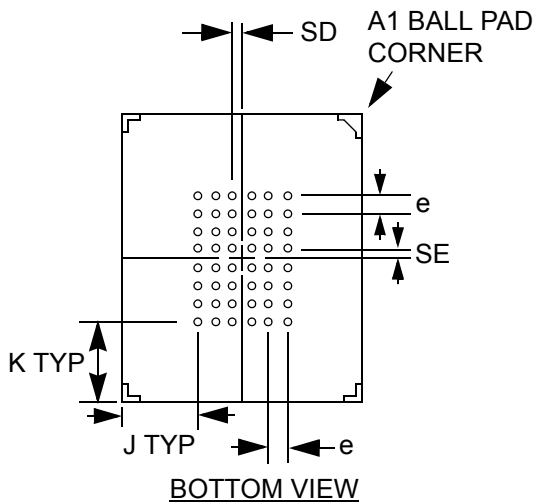
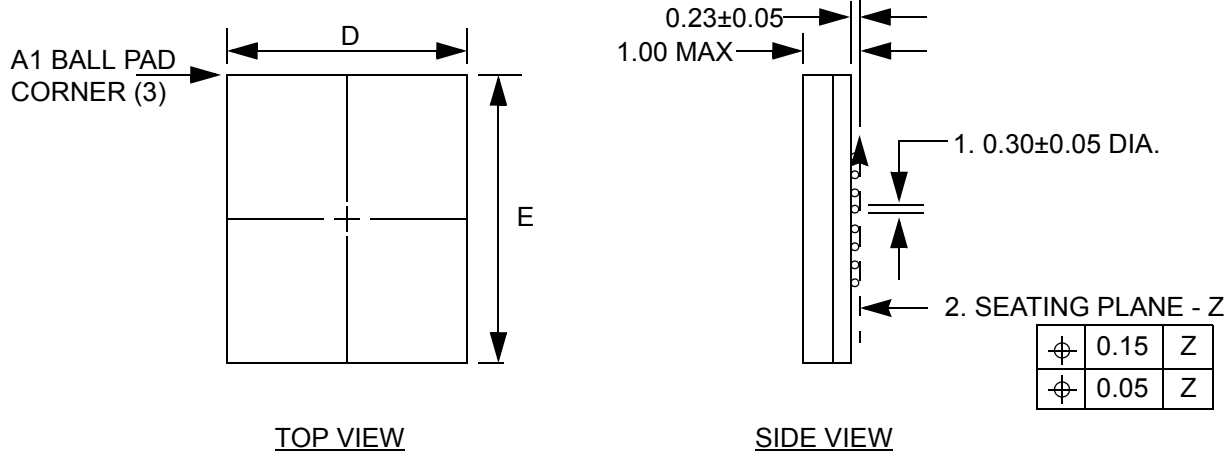
44 TSOP II Package (Z44)



Note:

1. All dimensions in inches (Millimeters)

VFBGA Package

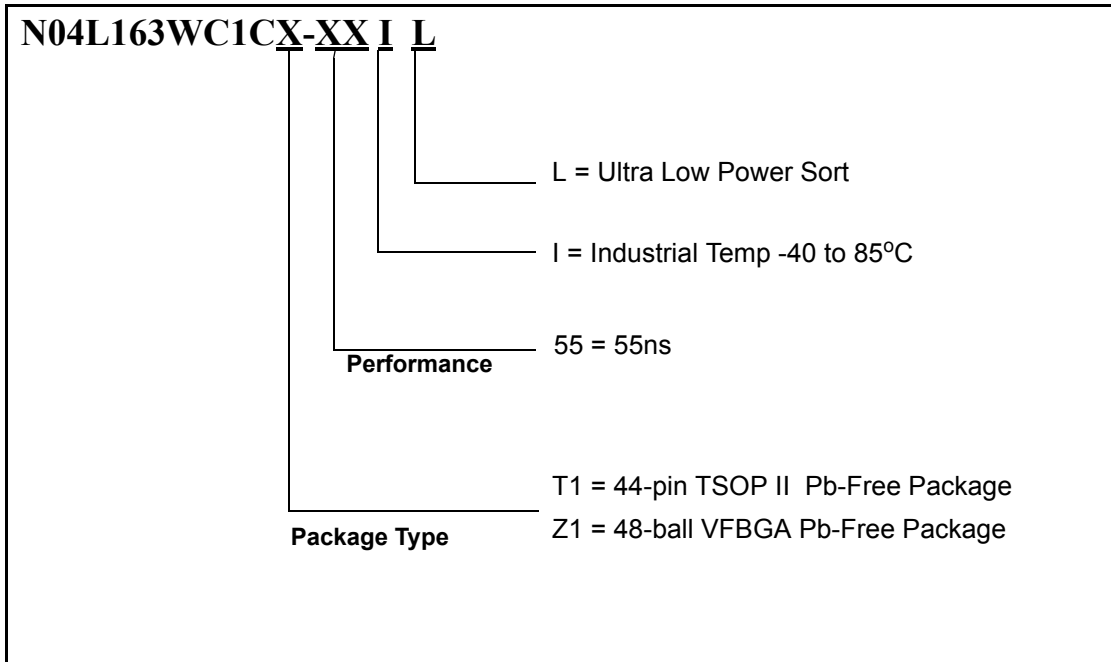


1. DIMENSION IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER. PARALLEL TO PRIMARY Z.
2. PRIMARY DATUM Z AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
3. A1 BALL PAD CORNER I.D. TO BE MARKED BY INK.

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	Oct 6. 2004	Initial Preliminary Release
B	Nov 8. 2004	General Update
C	Jan 14. 2005	General Update

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