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N02L163WN1A

2*Mb Ultra-Low Power Asynchronous CMOS SRAM* 128*K* × 16*bit*

Overview

The N02L163WN1A is an integrated memory device containing a 2 Mbit Static Random Access Memory organized as 131,072 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 (CE) control and output enable (OE) to allow for easy memory expansion. Byte controls (UB and LB) allow the upper and lower bytes to be accessed independently. The N02L163WN1A 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 128Kb x 16 SRAMs.

Features

- Single Wide Power Supply Range 2.3 to 3.6 Volts
- Very low standby current 2.0µA at 3.0V (Typical)
- Very low operating current 2.0mA at 3.0V and 1µs (Typical)
- Very low Page Mode operating current 0.8mA at 3.0V and 1µs (Typical)
- Simple memory control Single Chip Enable (CE) Byte control for independent byte operation Output Enable (OE) for memory expansion
- Low voltage data retention Vcc = 1.8V
- Very fast output enable access time 30ns OE access time
- Automatic power down to standby mode
- TTL compatible three-state output driver
- Compact space saving BGA package available

Part Number	Package Type	Operating Temperature	Power Supply (Vcc)	Speed	Standby Current (I _{SB}), Typical	Operating Current (Icc), Typical
N02L163WN1AB	48 - BGA					2 mA @ 1MHz
N02L163WN1AT	44 - TSOP II	-40°C to +85°C		55ns @ 2.7V 70ns @ 2.3V		
N02L163WN1AB1	48 - BGA Pb-Free		2.30 - 3.00			
N02L163WN1AT2	44 - TSOP II Green					

Product Family

(DOC# 14-02-014 REV L ECN# 01-1000)

Pin Configurations

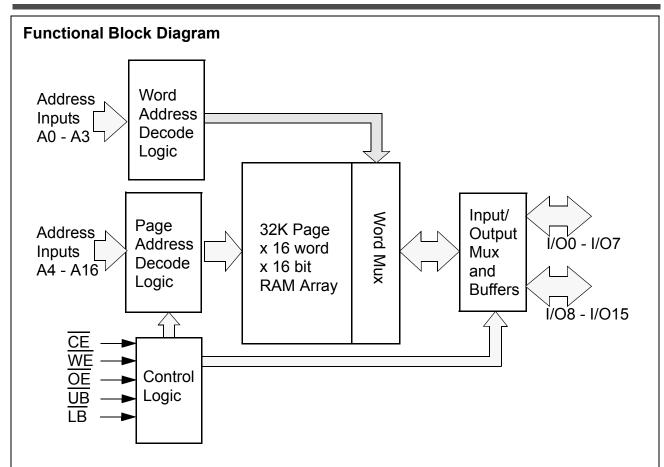


	1	2	3	4	5	6		
		~		-	5	0		
А	LB	OE	A ₀	A ₁	A ₂	NC		
В	I/O ₈	в	A ₃	A4	E	I/O ₀		
С	I/O ₉	I/O ₁₀	A ₅	A ₆	I/O ₁	I/O ₂		
D	\mathbf{v}_{ss}	I/O ₁₁	NC	A ₇	I/O ₃	v_{cc}		
Е	v_{cc}	I/O ₁₂	NC	A ₁₆	I/O ₄	\mathbf{v}_{ss}		
F	I/O ₁₄	I/O ₁₃	A ₁₄	A ₁₅	I/O ₅	I/O ₆		
G	G 1/015 NC A12 A13 WE 1/0							
H NC A8 A9 A10 A11 N								
48 Pin BGA (top)								
		6>	(8 n	nm				

Pin Descriptions

Pin Name	Pin Function		
A ₀ -A ₁₆	Address Inputs		
WE	Write Enable Input		
CE	Chip Enable Input		
OE	Output Enable Input		
LB	Lower Byte Enable Input		
UB	Upper Byte Enable Input		
I/O ₀ -I/O ₁₅	Data Inputs/Outputs		
NC	Not Connected		
V _{CC}	Power		
V _{SS}	Ground		

(DOC# 14-02-014 REV L ECN# 01-1000) The specifications of this device are subject to change without notice. For latest documentation see http://www.nanoamp.com.



Functional Description

CE	WE	OE	UB	LB	I/O ₀ - I/O ₁₅ ¹	MODE	POWER
Н	Х	Х	Х	Х	High Z	Standby ²	Standby
L	Х	Х	Н	Н	High Z	Active	Active
L	L	X ³	L ¹	L^1	Data In	Write ³	Active
L	Н	L	L ¹	L ¹	Data Out	Read	Active
L	Н	Н	Х	Х	High Z	Active	Active

1. When $\overline{\text{UB}}$ and $\overline{\text{LB}}$ are in select mode (low), I/O₀ - I/O₁₅ are affected as shown. When $\overline{\text{LB}}$ only is in the select mode only I/O₀ - I/O₇ are affected as shown. When $\overline{\text{UB}}$ is in the select mode only I/O₈ - I/O₁₅ are affected as shown.

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

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

Capacitance¹

Item	Symbol	Test Condition	Min	Мах	Unit
Input Capacitance	C _{IN}	V _{IN} = 0V, f = 1 MHz, T _A = 25 ^o C		8	pF
I/O Capacitance	C _{I/O}	V _{IN} = 0V, f = 1 MHz, T _A = 25 ^o C		8	pF

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

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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	PD	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 ⁰ C, 10sec	°C

 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}		2.3		3.6	V
Data Retention Voltage	V_{DR}	Chip Disabled ²	1.8			V
Input High Voltage	V _{IH}		1.8		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	Ι _{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 ²	I _{CC1}	V_{CC} =3.6 V, V_{IN} = V_{IH} or V_{IL} Chip Enabled, I_{OUT} = 0		2.0	4.0	mA
Read/Write Operating Supply Current @ 70 ns Cycle Time ²	I _{CC2}	V_{CC} =3.6 V, V_{IN} = V_{IH} or V_{IL} Chip Enabled, I_{OUT} = 0		12	16.0	mA
Page Mode Operating Supply Current @ 70ns Cycle Time ² (Refer to Power Savings with Page Mode Operation diagram)	I _{CC3}	V _{CC} =3.6 V, V _{IN} =V _{IH} or V _{IL} Chip Enabled, I _{OUT} = 0		4		mA
Read/Write Quiescent Operating Sup- ply Current ³	I _{CC4}	V_{CC} =3.6 V, V_{IN} = V_{IH} or V_{IL} Chip Enabled, I_{OUT} = 0, f = 0			3.0	mA
Maximum Standby Current ³	I _{SB1}	V _{IN} = V _{CC} or 0V Chip Disabled t _A = 85°C, VCC = 3.6 V		2.0	20	μA
Maximum Data Retention Current ³	I _{DR}	V_{CC} = 1.8V, V_{IN} = V_{CC} or 0 Chip Disabled, t_A = 85°C			10	μΑ

1. Typical values are measured at Vcc=Vcc 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.

 This device assumes a standby mode if the chip is disabled (CE high). In order to achieve low standby current all inputs must be within 0.2 volts of either VCC or VSS

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Power Savings with	Page Mode	Operation	(WE =	V _{IH})
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Page Ad	dress (A4 - A16)	Open page	
Word Ad	dress (A0 - A3)	Word 1 X Word 2 X X Word 1	8
CE			
ŌĒ			
LB, UB			

Note: Page mode operation is a method of addressing the SRAM to save operating current. The internal organization of the SRAM is optimized to allow this unique operating mode to be used as a valuable power saving feature.

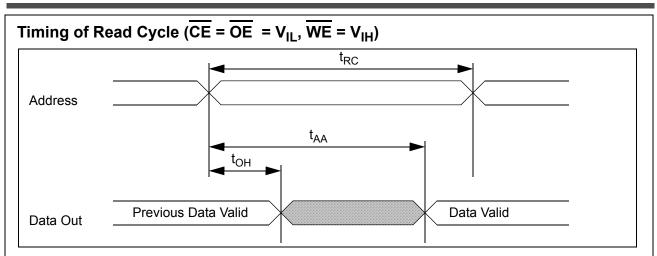
The only thing that needs to be done is to address the SRAM in a manner that the internal page is left open and 16-bit words of data are read from the open page. By treating addresses A0-A3 as the least significant bits and addressing the 16 words within the open page, power is reduced to the page mode value which is considerably lower than standard operating currents for low power SRAMs.

Timing Test Conditions

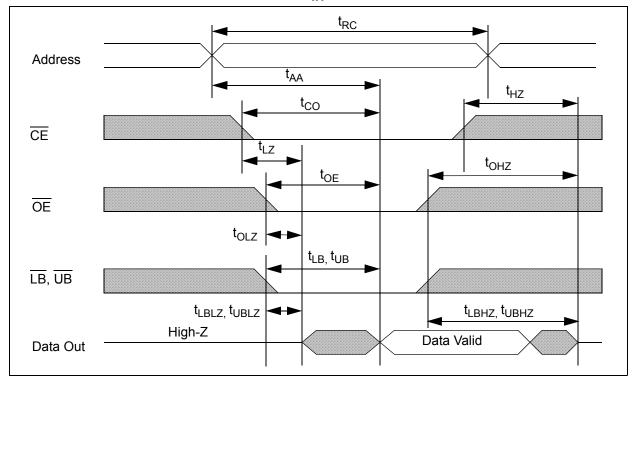
Item	
Input Pulse Level	0.1V _{CC} to 0.9 V _{CC}
Input Rise and Fall Time	5ns
Input and Output Timing Reference Levels	0.5 V _{CC}
Output Load	CL = 30pF
Operating Temperature	-40 to +85 °C

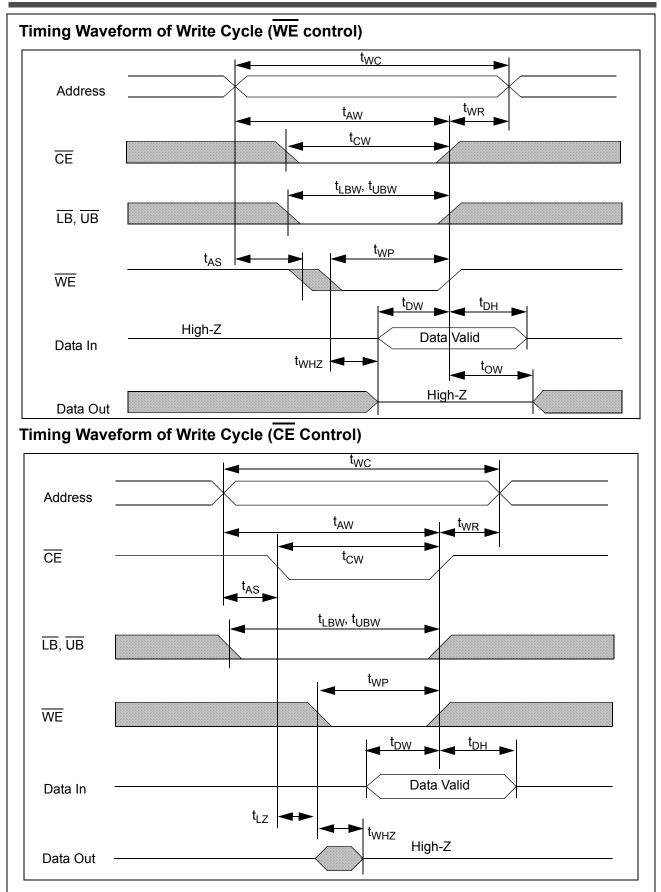
Timing

lterr	Cumhal	2.3 - 3.6 V		2.7 -	3.6 V	Unite
ltem	Symbol	Min.	Max.	Min.	Max.	Units
Read Cycle Time	t _{RC}	70		55		ns
Address Access Time	t _{AA}		70		55	ns
Chip Enable to Valid Output	t _{co}		70		55	ns
Output Enable to Valid Output	t _{OE}		35		30	ns
Byte Select to Valid Output	t _{LB} , t _{UB}		35		30	ns
Chip Enable to Low-Z output	t _{LZ}	10		10		ns
Output Enable to Low-Z Output	t _{OLZ}	5		5		ns
Byte Select to Low-Z Output	t _{LBZ} , t _{UBZ}	10		10		ns
Chip Disable to High-Z Output	t _{HZ}	0	20	0	20	ns
Output Disable to High-Z Output	t _{OHZ}	0	20	0	20	ns
Byte Select Disable to High-Z Output	t _{LBHZ} , t _{UBHZ}	0	20	0	20	ns
Output Hold from Address Change	t _{OH}	10		10		ns
Write Cycle Time	t _{WC}	70		55		ns
Chip Enable to End of Write	t _{CW}	50		40		ns
Address Valid to End of Write	t _{AW}	50		40		ns
Byte Select to End of Write	t _{LBW} , t _{UBW}	50		40		ns
Write Pulse Width	t _{WP}	40		40		ns
Address Setup Time	t _{AS}	0		0		ns
Write Recovery Time	t _{WR}	0		0		ns
Write to High-Z Output	t _{WHZ}		20		20	ns
Data to Write Time Overlap	t _{DW}	40		35		ns
Data Hold from Write Time	t _{DH}	0		0		ns
End Write to Low-Z Output	t _{ow}	10		10		ns

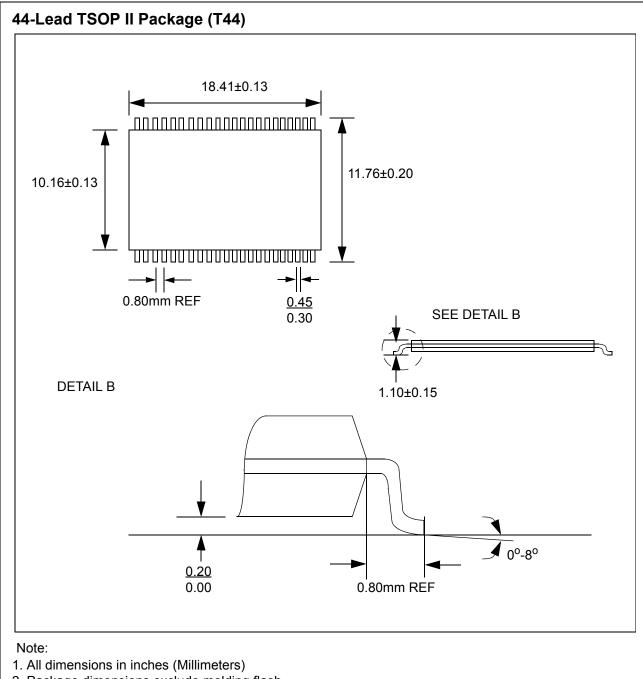


Timing Waveform of Read Cycle ($\overline{WE} = V_{IH}$)



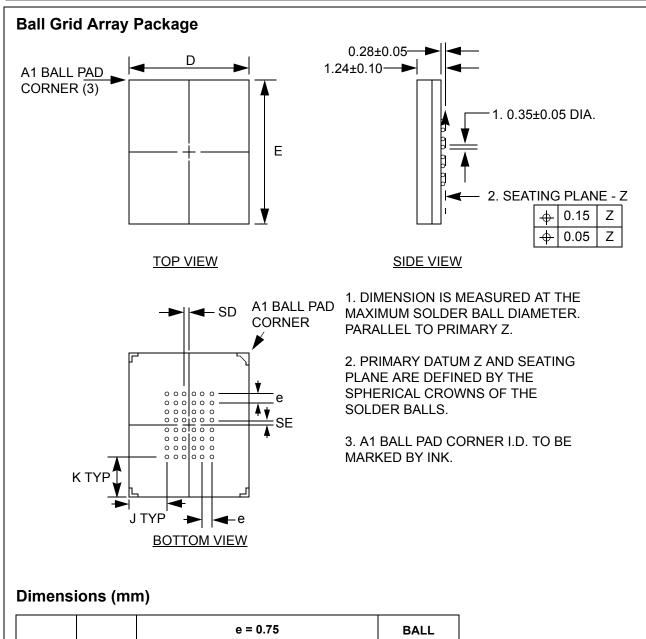


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2. Package dimensions exclude molding flash

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D	Е		BALL			
D	L	SD	SE	J	К	TYPE
6±0.10	8±0.10	0.375	0.375	1.125	1.375	FULL

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Ordering Information N02L163WN1AX-XX X Temperature I = Industrial, -40°C to 85°C Performance 55 = 55ns Package Type T = 44-pin TSOP II B = 48-ball BGA T2 = 44-pin TSOP II Green Package B1 = 48-ball BGA Pb-Free Package

Revision History

Revision #	Date	Change Description
A	Dec. 1999	Initial Preliminary Release
В	Sept. 2000	Modified Voltage Range and Standby Current Limits.
С	Oct. 2000	Added Missing Tas Parameter Specification.
D	Oct. 2000	Modified Standby Current Specifications.
E	Jan. 2001	Extensive Modification to use voltage regulator design
F	Mar. 2001	Modified BGA pinout, access time 70ns @ 2.7V, misc. errata
G	May 2001	Changed access time to 55ns, modified 44-Lead TSOP Package diagram
Н	June 2001	Revised voltage range in Timing table, revised Dimensions table
I	Sept. 2001	Minor parametric modifications, full production release
J	Dec. 2001	Part number change from EM128L16, modified Overview and Features, added Page Mode Operation diagram, revised Operating Characteristics table, Package diagram, Functional Description table and Ordering Information diagram
К	Nov. 2002	Replaced Isb and Icc on Product Family table with typical values
L	Oct. 2004	Added Pb-Free and Green Package Option

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