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**64M Bits(4Mx16) LOW POWER CMOS SRAM**

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**REVISION HISTORY****AS6C6416-55TIN 48pin TSOP1**

Revision	Description	Issue Date
Rev. 1.0	Initial Issue	July.2017

## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### FEATURES

- Fast access time : 55ns
- Low power consumption:  
Operating current : 12mA (TYP.)  
Standby current : 12 $\mu$ A(TYP.)
- Single 2.7V ~ 3.6V power supply
- All inputs and outputs TTL compatible
- Fully static operation
- Tri-state output
- Data byte control :
  - (i) BYTE# fixed to V<sub>CC</sub>  
LB# controlled DQ0 ~ DQ7  
UB# controlled DQ8 ~ DQ15
  - (ii) BYTE# fixed to V<sub>SS</sub>  
DQ15 used as address pin, while  
DQ8~DQ14 pins not used
- Data retention voltage : 1.2V (MIN.)
- **ROHS Compliant-Pb free**
- Package : 48-pin 12mm x 20mm TSOP I

### GENERAL DESCRIPTION

The AS6C6416 is a 67,108,864-bit low power CMOS static random access memory organized as 4,194,304 words by 16 bits or 8,388,608 words by 8 bits. It is fabricated using very high performance, high reliability CMOS technology. Its standby current is stable within the range of operating temperature.

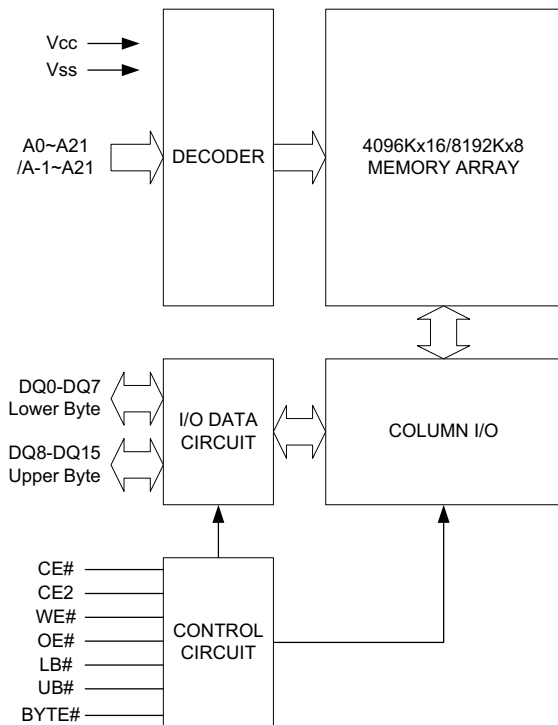
The AS6C6416 is well designed for low power application, and particularly well suited for battery back-up nonvolatile memory application.

The AS6C6416 operates from a single power supply of 2.7V ~ 3.6V and all inputs and outputs are fully TTL compatible

### PRODUCT FAMILY

Product Family	Operating Temperature	V <sub>CC</sub> Range	Speed	Power Dissipation	
				Standby(I <sub>SB1</sub> , TYP.)	Operating(I <sub>CC</sub> , TYP.)
AS6C6416-55TIN	-40 ~ 85°C	2.7 ~ 3.6V	55ns	12 $\mu$ A	12mA

### FUNCTIONAL BLOCK DIAGRAM

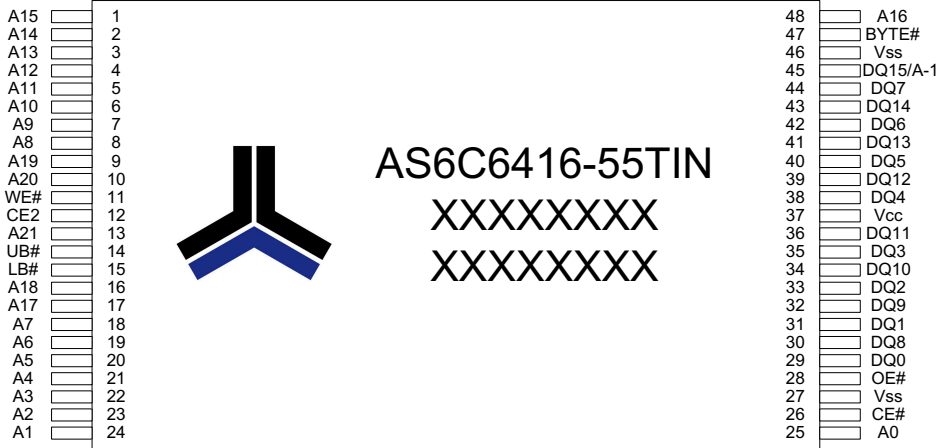


### PIN DESCRIPTION

SYMBOL	DESCRIPTION
A0 - A21	Address Inputs(word mode)
A-1 - A21	Address Inputs(byte mode)
DQ0 - DQ15	Data Inputs/Outputs
CE#, CE2	Chip Enable Input
WE#	Write Enable Input
OE#	Output Enable Input
LB#	Lower Byte Control
UB#	Upper Byte Control
BYTE#	Byte Enable
V <sub>CC</sub>	Power Supply
V <sub>SS</sub>	Ground

## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### PIN CONFIGURATION



TSOP I

## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### ABSOLUTE MAXIMUM RATINGS\*

PARAMETER	SYMBOL	RATING	UNIT
Voltage on V <sub>CC</sub> relative to V <sub>SS</sub>	V <sub>T1</sub>	-0.5 to 4.6	V
Voltage on any other pin relative to V <sub>SS</sub>	V <sub>T2</sub>	-0.5 to V <sub>CC</sub> +0.5	V
Operating Temperature	T <sub>A</sub>	-40 to 85	°C
Storage Temperature	T <sub>STG</sub>	-65 to 150	°C
Power Dissipation	P <sub>D</sub>	1	W
DC Output Current	I <sub>OUT</sub>	50	mA

\*Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to the absolute maximum rating conditions for extended period may affect device reliability.

### TRUTH TABLE

MODE	CE#	CE2	BYTE#	OE#	WE#	LB#	UB#	I/O OPERATION			SUPPLY CURRENT
								DQ0-DQ7	DQ8-DQ14	DQ15	
Standby	H	X	X	X	X	X	X	High-Z	High-Z	High-Z	I <sub>SB1</sub>
	X	L	X	X	X	X	X	High-Z	High-Z	High-Z	
	X	X	H	X	X	H	H	High-Z	High-Z	High-Z	
Output Disable	L	H	H	H	H	L	X	High-Z	High-Z	High-Z	I <sub>CC</sub> , I <sub>CC1</sub>
	L	H	H	H	H	X	L	High-Z	High-Z	High-Z	
	L	H	L	H	H	L	L	High-Z	High-Z	A-1	
Read	L	H	H	L	H	L	H	D <sub>OUT</sub>	High-Z	High-Z	I <sub>CC</sub> , I <sub>CC1</sub>
	L	H	H	L	H	H	L	High-Z	D <sub>OUT</sub>	D <sub>OUT</sub>	
	L	H	H	L	H	L	L	D <sub>OUT</sub>	D <sub>OUT</sub>	D <sub>OUT</sub>	
Write	L	H	H	X	L	L	H	D <sub>IN</sub>	High-Z	High-Z	I <sub>CC</sub> , I <sub>CC1</sub>
	L	H	H	X	L	H	L	High-Z	D <sub>IN</sub>	D <sub>IN</sub>	
	L	H	H	X	L	L	L	D <sub>IN</sub>	D <sub>IN</sub>	D <sub>IN</sub>	
Byte# Read	L	H	L	L	H	L	L	D <sub>OUT</sub>	High-Z	A-1	I <sub>CC</sub> , I <sub>CC1</sub>
Byte # Write	L	H	L	X	L	L	L	D <sub>IN</sub>	High-Z	A-1	I <sub>CC</sub> , I <sub>CC1</sub>

Notes:

1. H = V<sub>IH</sub>, L = V<sub>IL</sub>, X = Don't care.

2. The BYTE# pin has to be tied to V<sub>CC</sub> to use the device as a 4M x 16 SRAM, and to be tied to V<sub>SS</sub> as a 8M x 8 SRAM.

In the 8M x 8 configuration, Pin 45 is A-1, and both UB# and LB# are tied to V<sub>SS</sub>, while DQ8 to DQ14 pins are not used.

## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP. <sup>*4</sup>	MAX.	UNIT	
Supply Voltage	V <sub>CC</sub>		2.7	3.0	3.6	V	
Input High Voltage	V <sub>IH</sub> <sup>1</sup>		2.2	-	V <sub>CC</sub> +0.3	V	
Input Low Voltage	V <sub>IL</sub> <sup>2</sup>		- 0.2	-	0.6	V	
Input Leakage Current	I <sub>LI</sub>	V <sub>CC</sub> ≧ V <sub>IN</sub> ≧ V <sub>SS</sub>	- 1	-	1	μA	
Output Leakage Current	I <sub>LO</sub>	V <sub>CC</sub> ≧ V <sub>OUT</sub> ≧ V <sub>SS</sub> Output Disabled	- 1	-	1	μA	
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -1mA	2.2	2.7	-	V	
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 2mA	-	-	0.4	V	
Average Operating Power supply Current	I <sub>CC</sub>	Cycle time = MIN. CE# ≧ 0.2V and CE2 ≧ V <sub>CC</sub> -0.2V I <sub>I/O</sub> = 0mA Other pins at 0.2V or V <sub>CC</sub> -0.2V	-	12	20	mA	
	I <sub>CC1</sub>	Cycle time = 1μs CE# ≧ 0.2V and CE2 ≧ V <sub>CC</sub> -0.2V I <sub>I/O</sub> = 0mA Other pins at 0.2V or V <sub>CC</sub> -0.2V	-	3	5	mA	
Standby Power Supply Current	I <sub>SB1</sub>	CE# ≧ V <sub>CC</sub> -0.2V or CE2 ≧ 0.2V Other pins at 0.2V or V <sub>CC</sub> -0.2V	25°C <sup>*5</sup>	-	12	32	μA
			40°C <sup>*5</sup>	-	12	36	μA
			70°C	-	-	100	μA
			85°C	-	-	160	μA

Notes:

- V<sub>IH</sub>(max) = V<sub>CC</sub> + 2.0V for pulse width less than 6ns.
- V<sub>IL</sub>(min) = V<sub>SS</sub> - 2.0V for pulse width less than 6ns.
- Over/Undershoot specifications are characterized on engineering evaluation stage, not for mass production test.
- Typical values, measured at V<sub>CC</sub> = V<sub>CC</sub>(TYP.) and T<sub>A</sub> = 25°C, are included for reference only and are not guaranteed or tested.
- This parameter is measured at V<sub>CC</sub>=3.0V.

### CAPACITANCE (T<sub>A</sub> = 25°C, f = 1.0MHz)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Input Capacitance	C <sub>IN</sub>	-	15	pF
Input/Output Capacitance	C <sub>I/O</sub>	-	20	pF

Note : These parameters are guaranteed by device characterization, but not production tested.

## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### AC TEST CONDITIONS

Input Pulse Levels	0.2V to $V_{CC} - 0.2V$
Input Rise and Fall Times	3ns
Input and Output Timing Reference Levels	1.5V
Output Load	$C_L = 30pF + 1TTL, I_{OH}/I_{OL} = -1mA/2mA$

### AC ELECTRICAL CHARACTERISTICS

#### (1) READ CYCLE

PARAMETER	SYM.	AS6C6416-55TIN		UNIT
		MIN.	MAX.	
Read Cycle Time	$t_{RC}$	55	-	ns
Address Access Time	$t_{AA}$	-	55	ns
Chip Enable Access Time	$t_{ACE}$	-	55	ns
Output Enable Access Time	$t_{OE}$	-	30	ns
Chip Enable to Output in Low-Z	$t_{CLZ}^*$	10	-	ns
Output Enable to Output in Low-Z	$t_{OLZ}^*$	5	-	ns
Chip Disable to Output in High-Z	$t_{CHZ}^*$	-	20	ns
Output Disable to Output in High-Z	$t_{OHZ}^*$	-	20	ns
Output Hold from Address Change	$t_{OH}$	10	-	ns
LB#, UB# Access Time	$t_{BA}$	-	55	ns
LB#, UB# to High-Z Output	$t_{BHZ}^*$	-	20	ns
LB#, UB# to Low-Z Output	$t_{BLZ}^*$	10	-	ns

#### (2) WRITE CYCLE

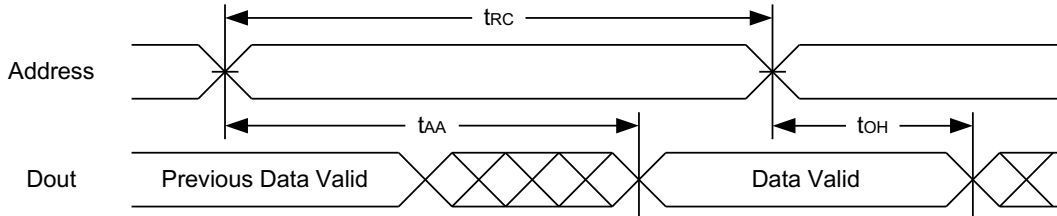
PARAMETER	SYM.	AS6C6416-55TIN		UNIT
		MIN.	MAX.	
Write Cycle Time	$t_{WC}$	55	-	ns
Address Valid to End of Write	$t_{AW}$	50	-	ns
Chip Enable to End of Write	$t_{CW}$	50	-	ns
Address Set-up Time	$t_{AS}$	0	-	ns
Write Pulse Width	$t_{WP}$	45	-	ns
Write Recovery Time	$t_{WR}$	0	-	ns
Data to Write Time Overlap	$t_{DW}$	25	-	ns
Data Hold from End of Write Time	$t_{DH}$	0	-	ns
Output Active from End of Write	$t_{OW}^*$	5	-	ns
Write to Output in High-Z	$t_{WHZ}^*$	-	20	ns
LB#, UB# Valid to End of Write	$t_{BW}$	50	-	ns

\*These parameters are guaranteed by device characterization, but not production tested.

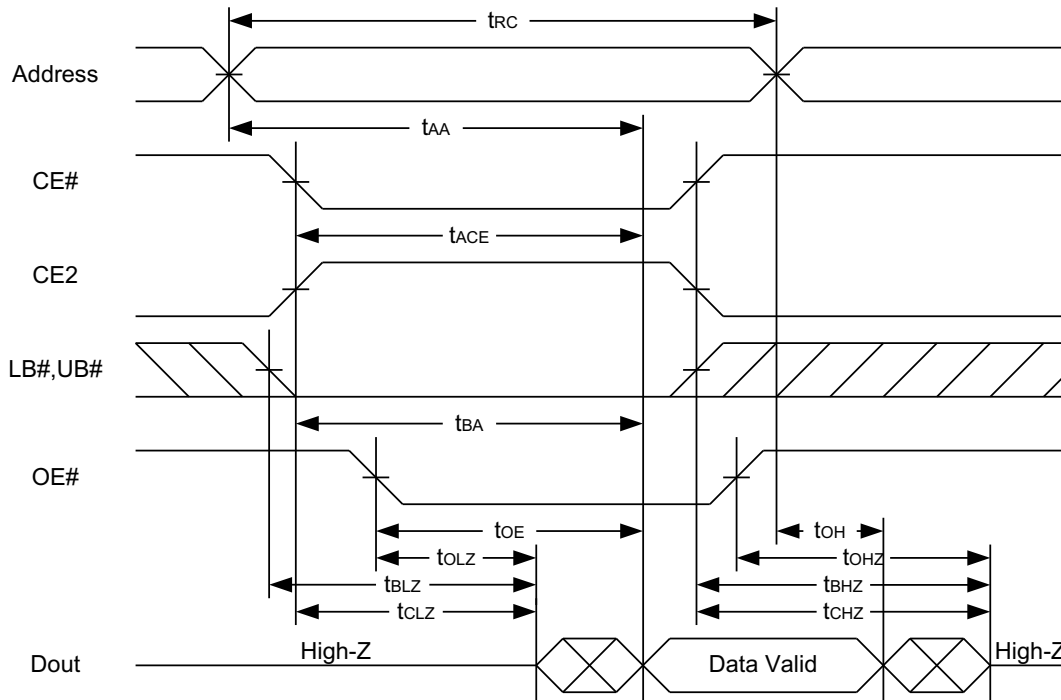
## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### TIMING WAVEFORMS

#### READ CYCLE 1 (Address Controlled) (1,2)



#### READ CYCLE 2 (CE# and CE2 and OE# Controlled) (1,3,4,5)

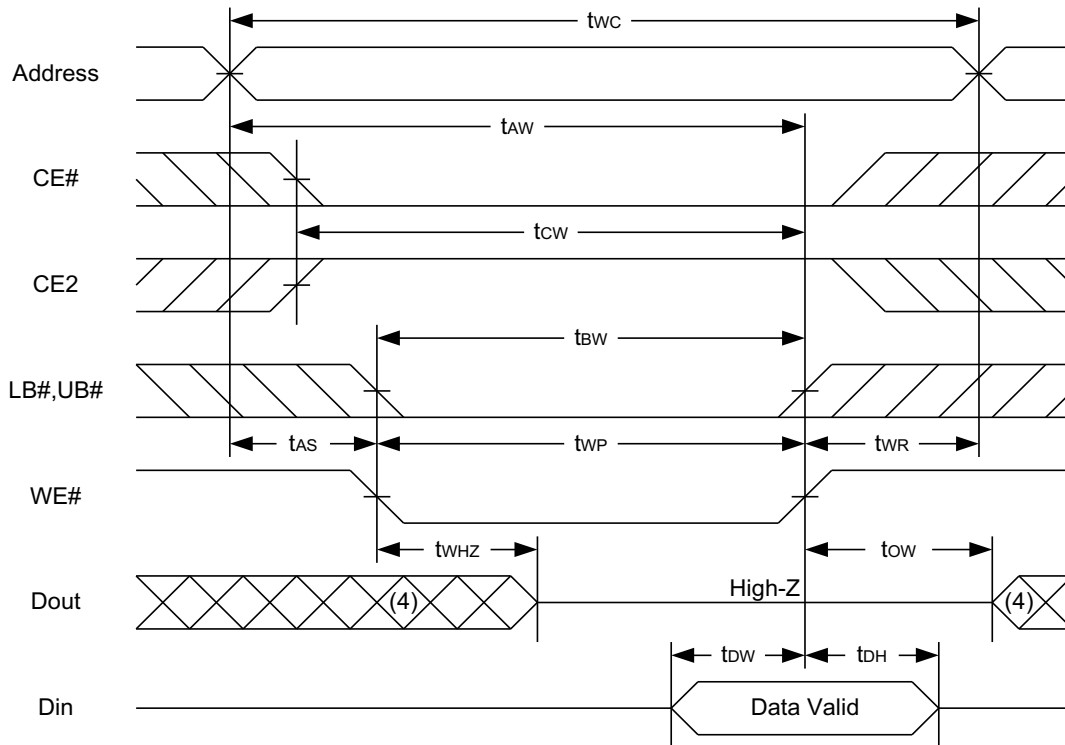


#### Notes :

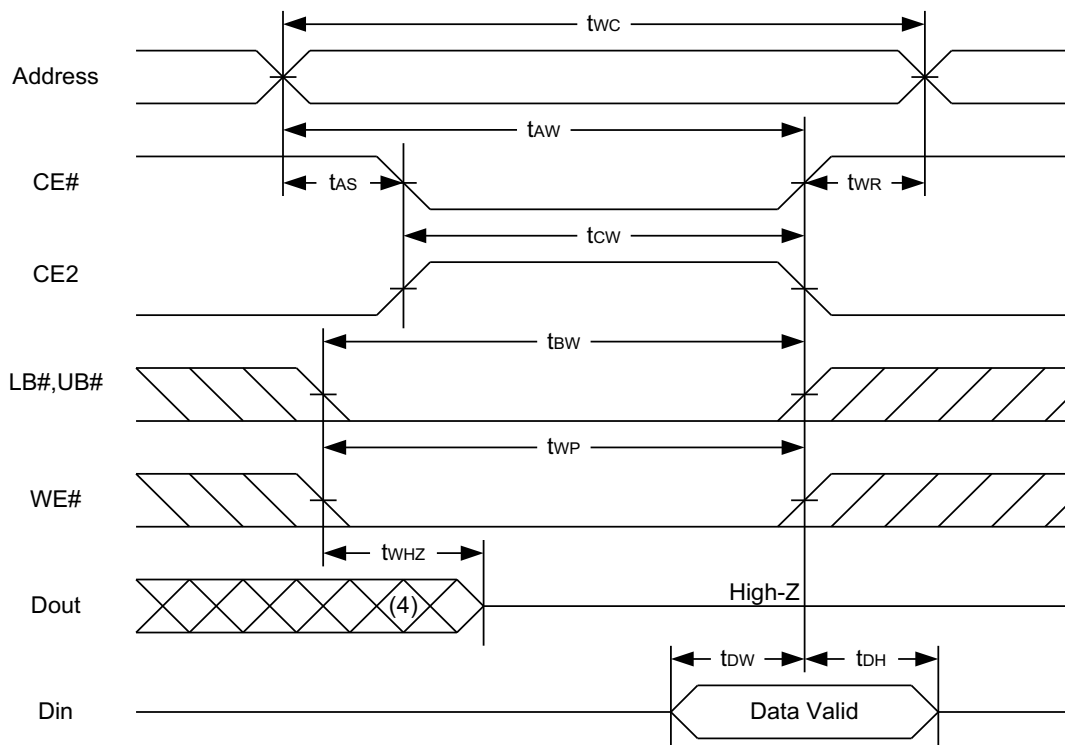
1. WE# is high for read cycle.
2. Device is continuously selected OE# = low, CE# = low, CE2 = high, LB# or UB# = low.
3. Address must be valid prior to or coincident with CE# = low, CE2 = high, LB# or UB# = low transition; otherwise  $t_{AA}$  is the limiting parameter.
4.  $t_{CLZ}$ ,  $t_{BLZ}$ ,  $t_{OLZ}$ ,  $t_{CHZ}$ ,  $t_{BHZ}$  and  $t_{OHZ}$  are specified with  $C_L = 5\text{pF}$ . Transition is measured  $\pm 500\text{mV}$  from steady state.
5. At any given temperature and voltage condition,  $t_{CHZ}$  is less than  $t_{CLZ}$ ,  $t_{BHZ}$  is less than  $t_{BLZ}$ ,  $t_{OHZ}$  is less than  $t_{OLZ}$ .

## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### WRITE CYCLE 1 (WE# Controlled) (1,2,4,5)



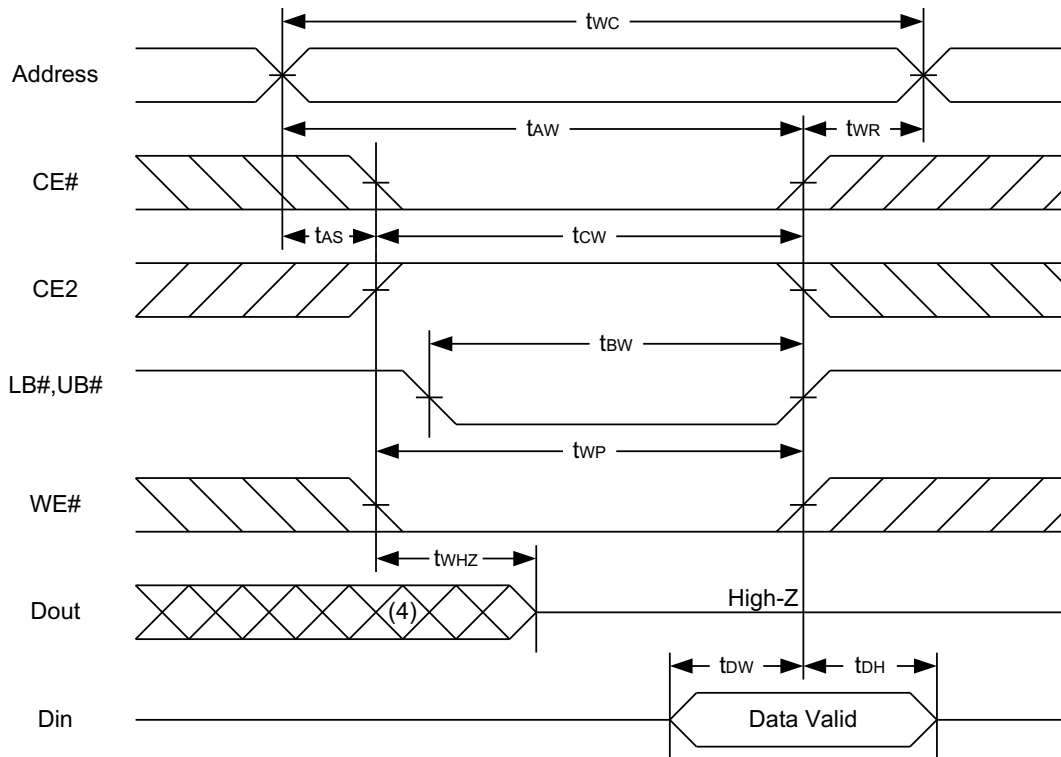
### WRITE CYCLE 2 (CE# and CE2 Controlled) (1,4,5)





## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### WRITE CYCLE 3 (LB#,UB# Controlled) (1,4,5)



#### Notes :

1. A write occurs during the overlap of a low CE#, high CE2, low WE#, LB# or UB# = low.
2. During a WE# controlled write cycle with OE# low,  $t_{wp}$  must be greater than  $t_{whz} + t_{dw}$  to allow the drivers to turn off and data to be placed on the bus.
3. During this period, I/O pins are in the output state, and input signals must not be applied.
4. If the CE#, LB#, UB# low transition and CE2 high transition occurs simultaneously with or after WE# low transition, the outputs remain in a high impedance state.
5.  $t_{ow}$  and  $t_{whz}$  are specified with  $C_L = 5\text{pF}$ . Transition is measured  $\pm 500\text{mV}$  from steady state.

## 64M Bits(4Mx16) LOW POWER CMOS SRAM

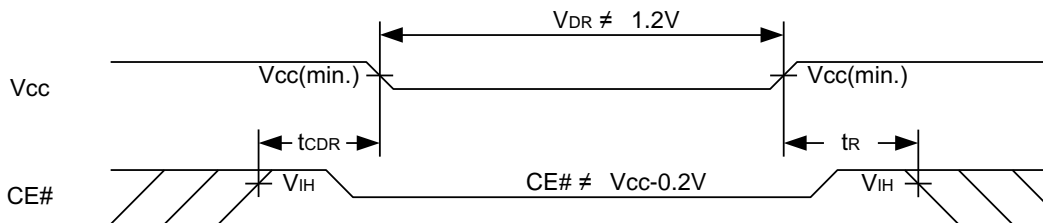
### DATA RETENTION CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
V <sub>CC</sub> for Data Retention	V <sub>DR</sub>	CE# $\geq$ V <sub>CC</sub> - 0.2V or CE2 $\leq$ 0.2V	1.2	-	3.6	V	
Data Retention Current	I <sub>DR</sub>	V <sub>CC</sub> = 1.2V CE# $\geq$ V <sub>CC</sub> -0.2V or CE2 $\leq$ 0.2V Other pins at 0.2V or V <sub>CC</sub> -0.2V	25°C	-	10	32	$\mu$ A
			40°C	-	10	36	$\mu$ A
			70°C	-	-	100	$\mu$ A
			85°C	-	-	160	$\mu$ A
Chip Disable to Data Retention Time	t <sub>CDR</sub>	See Data Retention Waveforms (below)	0	-	-	ns	
Recovery Time	t <sub>R</sub>		t <sub>RC</sub> *	-	-	ns	

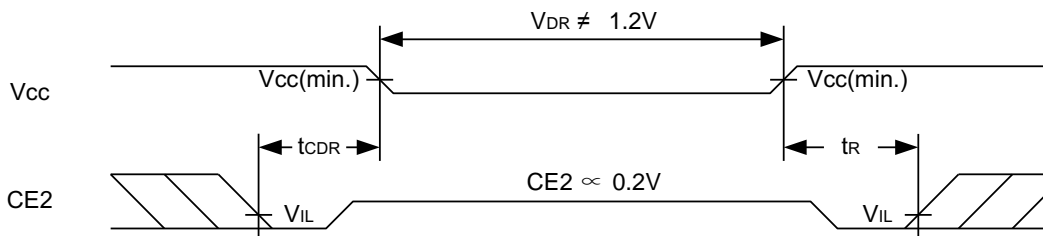
t<sub>RC</sub>\* = Read Cycle Time

### DATA RETENTION WAVEFORM

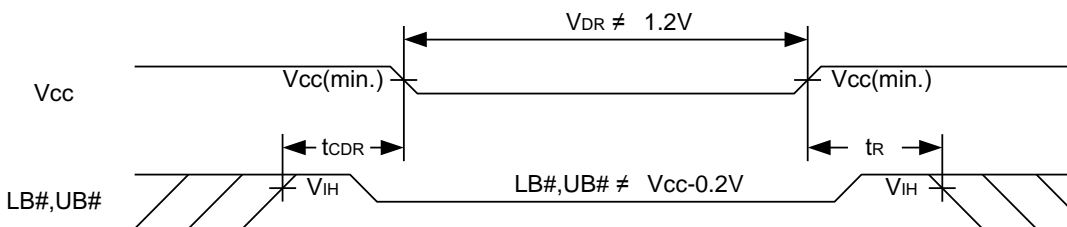
Low V<sub>CC</sub> Data Retention Waveform (1) (CE# controlled)



Low V<sub>CC</sub> Data Retention Waveform (2) (CE2 controlled)



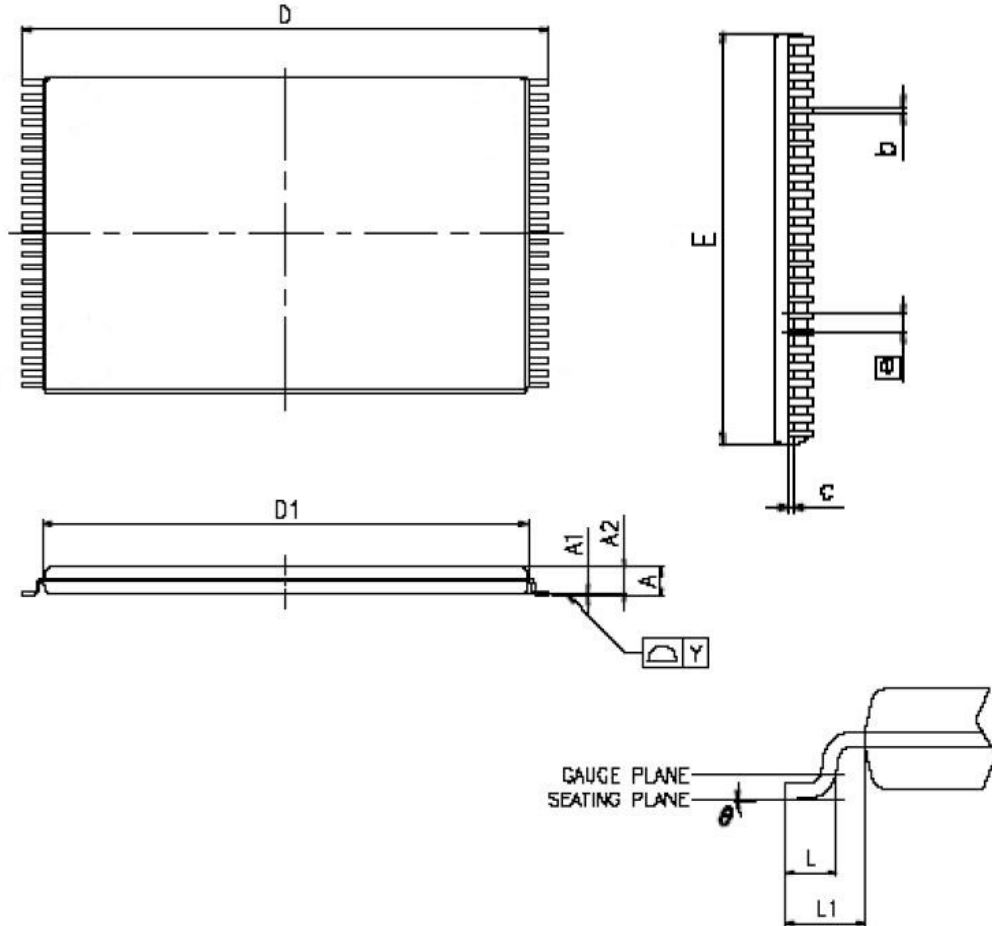
Low V<sub>CC</sub> Data Retention Waveform (3) (LB#, UB# controlled)




## 64M Bits(4Mx16) LOW POWER CMOS SRAM

### PACKAGE OUTLINE DIMENSION

#### 48-pin 12mm x 20mm TSOP I Package Outline Dimension



#### VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS	MIN.	NOM.	MAX
A	-	-	1.20
A1	0.05	-	0.15
A2	0.95	1.00	1.05
b	0.17	0.22	0.27
c	0.10	-	0.21
D	19.80	20.00	20.20
D1	18.30	18.40	18.50
E	11.90	12.00	12.10
	0.50 BASIC		
L	0.50	0.60	0.70
L1	-	0.80	-
Y	-	-	0.10
$\theta$	0°	-	5°

#### NOTES:

- 1 JEDEC OUTLINE : MO-142 DD
- 2.PROFILE TOLERANCE ZONES FOR D1 AND E DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION ON E IS 0.15mm PER SIDE AND ON D1 IS 0.25mm PER SIDE.
- 3.DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08mm TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT.

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## 64M Bits(4Mx16) LOW POWER CMOS SRAM

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### ORDERING INFORMATION

AS6C	6416	-55	T	I	N	XX
SRAM prefix	Device Number 64 = 64M 16 = x16	Access Time	Package Option T=48 pin TSOP I(12x20mm)	Temperature Range I = Industrial (-40 to + 85°C)	N = Lead Free RoHS compliant part	Packing Type None:Tray TR:Reel



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