

**Document Title**

**256Kx16 bit Low Power and Low Voltage CMOS Static RAM  
with 48-CSP(Chip Scale Package)**

**Revision History**

<b><u>Revision No.</u></b>	<b><u>History</u></b>	<b><u>Draft Date</u></b>	<b><u>Remark</u></b>
0.0	Initial draft - UB/LB power control	July 4, 1998	Preliminary
0.01	Errata correction	August 17, 1998	
0.1	Revise - Add 3.3V product : KM616V4010C	September 11, 1998	Preliminary
1.0	Revise	October 2, 1998	Final

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## 256Kx16 bit Low Power and Low Voltage CMOS Static RAM

### FEATURES

- Process Technology: TFT
- Organization: 256K x16
- Power Supply Voltage
  - KM616V4010C Family: 3.0~3.6V
  - KM616U4010C Family: 2.7~3.3V
- Low Data Retention Voltage: 2.0V(Min)
- Three state output and TTL Compatible
- Package Type: 48-CSP with 0.75mm ball pitch

### GENERAL DESCRIPTION

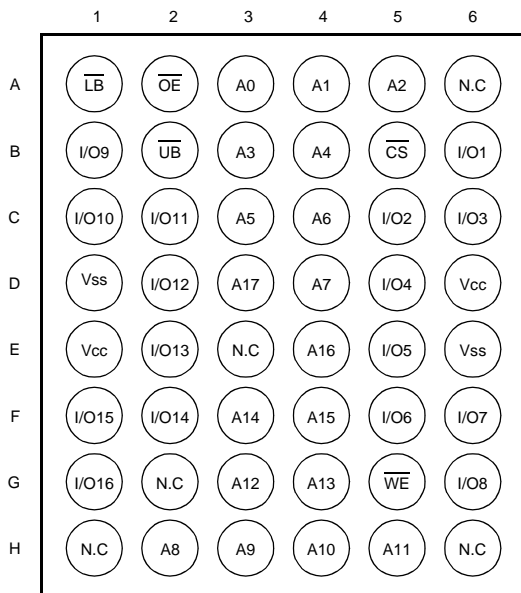
The KM616V4010C, KM616U4010C families are fabricated by SAMSUNG's advanced CMOS process technology. The families support industrial operating temperature ranges and have chip scale package for user flexibility of system design. The families also support low data retention voltage for battery back-up operation with low data retention current.

### PRODUCT FAMILY

Product Family	Operating Temperature	Vcc Range	Speed(ns)	Power Dissipation		PKG Type
				Standby (Isb1, Max)	Operating (Icc2, Max)	
KM616V4010CLZI-L	Industrial(-40~85°C)	3.0~3.6V	70 <sup>1)</sup> /85/100	20μA	45mA	48-CSP
KM616U4010CLZI-L		2.7~3.3V				

1. The parameter is measured with 30pF test load.

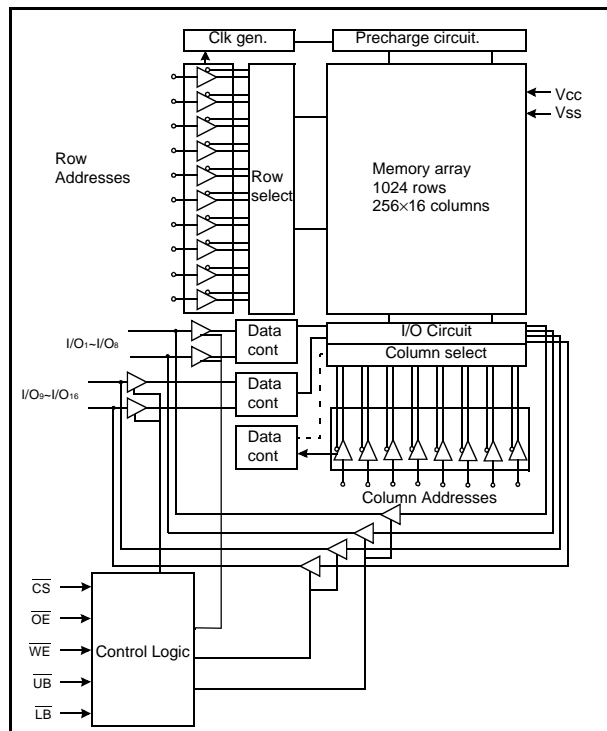
### PIN DESCRIPTION



48-ball CSP - Top View (Ball Down)

Name	Function	Name	Function
$\overline{CS}$	Chip Select Inputs	Vcc	Power
$\overline{OE}$	Output Enable Input	Vss	Ground
$\overline{WE}$	Write Enable Input	$\overline{UB}$	Upper Byte(I/O9~16)
A0~A17	Address Inputs	$\overline{LB}$	Lower Byte(I/O1~8)
I/O1~I/O16	Data Inputs/Outputs	NC	No Connection

### FUNCTIONAL BLOCK DIAGRAM



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## PRODUCT LIST

Industrial Temperature Products(-40~85°C)	
Part Name	Function
KM616V4010CLZI-7L KM616V4010CLZI-8L KM616V4010CLZI-10L	48-CSP with 0.75mm ball pitch, 70ns, 3.3V, LL 48-CSP with 0.75mm ball pitch, 85ns, 3.3V, LL 48-CSP with 0.75mm ball pitch, 100ns, 3.3V, LL
KM616U4010CLZI-7L KM616U4010CLZI-8L KM616U4010CLZI-10L	8-CSP with 0.75mm ball pitch, 70ns, 3.0V, LL 48-CSP with 0.75mm ball pitch, 85ns, 3.0V, LL 48-CSP with 0.75mm ball pitch, 100ns, 3.0V, LL

## FUNCTIONAL DESCRIPTION

$\overline{\text{CS}}$	$\overline{\text{OE}}$	$\overline{\text{WE}}$	$\overline{\text{LB}}$	$\overline{\text{UB}}$	I/O <sub>1~8</sub>	I/O <sub>9~16</sub>	Mode	Power
H	X <sup>1)</sup>	X <sup>1)</sup>	X <sup>1)</sup>	X <sup>1)</sup>	High-Z	High-Z	Deselected	Standby
X <sup>1)</sup>	X <sup>1)</sup>	X <sup>1)</sup>	H	H	High-Z	High-Z	Deselected	Standby
L	H	H	L	X <sup>1)</sup>	High-Z	High-Z	Output Disabled	Active
L	H	H	X <sup>1)</sup>	L	High-Z	High-Z	Output Disabled	Active
L	L	H	L	H	Dout	High-Z	Lower Byte Read	Active
L	L	H	H	L	High-Z	Dout	Upper Byte Read	Active
L	L	H	L	L	Dout	Dout	Word Read	Active
L	X <sup>1)</sup>	L	L	H	Din	High-Z	Lower Byte Write	Active
L	X <sup>1)</sup>	L	H	L	High-Z	Din	Upper Byte Write	Active
L	X <sup>1)</sup>	L	L	L	Din	Din	Word Write	Active

1. X means don't care. (Must be low or high state)

## ABSOLUTE MAXIMUM RATINGS<sup>1)</sup>

Item	Symbol	Ratings	Unit
Voltage on any pin relative to Vss	V <sub>IN</sub> , V <sub>OUT</sub>	-0.5 to V <sub>CC</sub> +0.5	V
Voltage on Vcc supply relative to Vss	V <sub>CC</sub>	-0.3 to 4.6	V
Power Dissipation	P <sub>D</sub>	1.0	W
Storage temperature	T <sub>STG</sub>	-65 to 150	°C
Operating Temperature	T <sub>A</sub>	-40 to 85	°C

1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Functional operation should be restricted to recommended operating condition. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## RECOMMENDED DC OPERATING CONDITIONS<sup>1)</sup>

Item	Symbol	Product	Min	Typ	Max	Unit
Supply voltage	V <sub>CC</sub>	KM616V4010CZ Family	3.0	3.3	3.6	V
		KM616U4010CZ Family	2.7	3.0	3.3	
Ground	V <sub>SS</sub>	KM616V4010CZ, KM616U4010CZ Family	0	0	0	V
Input high voltage	V <sub>IH</sub>	KM616V4010CZ, KM616U4010CZ Family	2.2	-	V <sub>CC</sub> +0.3 <sup>2)</sup>	V
Input low voltage	V <sub>IL</sub>	KM616V4010CZ, KM616U4010CZ Family	-0.3 <sup>3)</sup>	-	0.6	V

Note:

1. T<sub>A</sub>=-40 to 85°C, otherwise specified

2. Overshoot: V<sub>CC</sub>+2.0V in case of pulse width ≤ 30ns

3. Undershoot: -2.0V in case of pulse width ≤ 30ns

4. Overshoot and undershoot are sampled, not 100% tested.

## CAPACITANCE<sup>1)</sup> (f=1MHz, T<sub>A</sub>=25°C)

Item	Symbol	Test Condition	Min	Max	Unit
Input capacitance	C <sub>IN</sub>	V <sub>IN</sub> =0V	-	8	pF
Input/Output capacitance	C <sub>IO</sub>	V <sub>IO</sub> =0V	-	10	pF

1. Capacitance is sampled, not 100% tested

## DC AND OPERATING CHARACTERISTICS

Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Input leakage current	I <sub>LI</sub>	V <sub>IL</sub> =V <sub>SS</sub> to V <sub>CC</sub>	-1	-	1	μA
Output leakage current	I <sub>LO</sub>	$\overline{CS}$ =V <sub>IH</sub> or $\overline{OE}$ =V <sub>IH</sub> or $\overline{WE}$ =V <sub>IL</sub> V <sub>IO</sub> =V <sub>SS</sub> to V <sub>CC</sub>	-1	-	1	μA
Operating power supply current	I <sub>CC</sub>	I <sub>IO</sub> =0mA, $\overline{CS}$ =V <sub>IL</sub> , V <sub>IN</sub> =V <sub>IL</sub> or V <sub>IH</sub>	-	-	4	mA
Average operating current	I <sub>CC1</sub>	Cycle time=1μs, 100% duty, I <sub>IO</sub> =0mA $\overline{CS}$ ≤0.2V, V <sub>IN</sub> ≤0.2V or V <sub>IN</sub> ≥V <sub>CC</sub> -0.2V	-	-	6	mA
	I <sub>CC2</sub>	Cycle time=Min, 100% duty, I <sub>IO</sub> =0mA,	-	-	45	mA
Output low voltage	V <sub>OL</sub>	I <sub>OL</sub> =2.1mA	-	-	0.4	V
Output high voltage	V <sub>OH</sub>	I <sub>OH</sub> =-1.0mA	2.2	-	-	V
Standby Current(TTL)	I <sub>SB</sub>	$\overline{CS}$ =V <sub>IH</sub> or $\overline{LB}$ = $\overline{UB}$ =V <sub>IH</sub> , Other inputs=V <sub>IH</sub> or V <sub>IL</sub>	-	-	0.3	mA
Standby Current(CMOS)	I <sub>SB1</sub>	$\overline{CS}$ ≥V <sub>CC</sub> -0.2V or $\overline{LB}$ = $\overline{UB}$ ≥V <sub>CC</sub> -0.2V, $\overline{CS}$ ≤0.2V, Other inputs=0~V <sub>CC</sub>	-	-	20	μA

## AC OPERATING CONDITIONS

### TEST CONDITIONS (Test Load and Input/Output Reference)

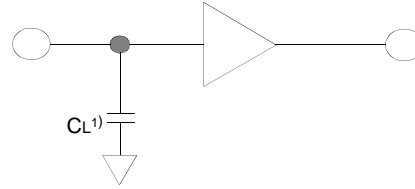
Input pulse level: 0.4 to 2.2V

Input rising and falling time: 5ns

Input and output reference voltage: 1.5V

Output load (see right):  $C_L = 100\text{pF} + 1\text{TTL}$

$C_L = 30\text{pF} + 1\text{TTL}$



1. Including scope and jig capacitance

## AC CHARACTERISTICS (TA=-40 to 85°C, KM616V4010C Family: Vcc=3.0~3.6V, KM616U4010C Family: Vcc=2.7~3.3V)

Parameter List		Symbol	Speed Bins						Units
			70ns		85ns		100ns		
			Min	Max	Min	Max	Min	Max	
Read	Read cycle time	t <sub>RC</sub>	70	-	85	-	100	-	ns
	Address access time	t <sub>AA</sub>	-	70	-	85	-	100	ns
	Chip select to output	t <sub>CO</sub>	-	70	-	85	-	100	ns
	Output enable to valid output	t <sub>OE</sub>	-	35	-	40	-	50	ns
	$\overline{\text{LB}}$ , $\overline{\text{UB}}$ valid to data output	t <sub>BA</sub>	-	70	-	85	-	100	ns
	Chip select to low-Z output	t <sub>LZ</sub>	10	-	10	-	10	-	ns
	Output enable to low-Z output	t <sub>OLZ</sub>	5	-	5	-	5	-	ns
	$\overline{\text{LB}}$ , $\overline{\text{UB}}$ enable to low-Z output	t <sub>BLZ</sub>	10	-	10	-	10	-	ns
	Chip disable to high-Z output	t <sub>HZ</sub>	0	25	0	25	0	30	ns
	Output hold from address change	t <sub>OH</sub>	10	-	10	-	15	-	ns
	$\overline{\text{OE}}$ disable to high-Z output	t <sub>OHZ</sub>	0	25	0	25	0	30	ns
	$\overline{\text{UB}}$ , $\overline{\text{LB}}$ disable to high-Z output	t <sub>BHZ</sub>	0	25	0	25	0	30	ns
Write	Write cycle time	t <sub>WC</sub>	70	-	85	-	100	-	ns
	Chip select to end of write	t <sub>CW</sub>	60	-	70	-	80	-	ns
	Address set-up time	t <sub>AS</sub>	0	-	0	-	0	-	ns
	Address valid to end of write	t <sub>AW</sub>	60	-	70	-	80	-	ns
	Write pulse width	t <sub>WP</sub>	55	-	55	-	70	-	ns
	Write recovery time	t <sub>WR</sub>	0	-	0	-	0	-	ns
	Write to output high-Z	t <sub>WHZ</sub>	0	25	0	25	0	30	ns
	Data to write time overlap	t <sub>DW</sub>	30	-	35	-	40	-	ns
	Data hold from write time	t <sub>DH</sub>	0	-	0	-	0	-	ns
	End write to output low-Z	t <sub>OW</sub>	5	-	5	-	5	-	ns
	$\overline{\text{LB}}$ , $\overline{\text{UB}}$ valid to end of write	t <sub>BW</sub>	60	-	70	-	80	-	ns

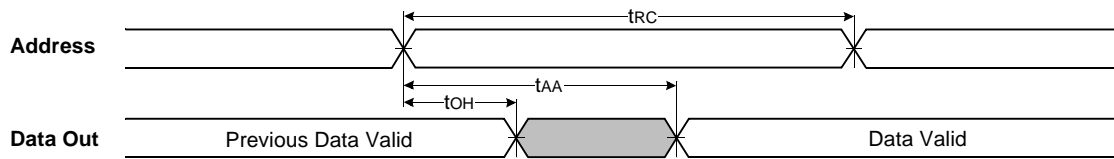
## DATA RETENTION CHARACTERISTICS

Item	Symbol	Test Condition	Min	Typ	Max	Unit
Vcc for data retention	V <sub>DR</sub>	$\overline{\text{CS}} \geq V_{\text{cc}} - 0.2\text{V}^{(1)}$	2.0	-	3.6	V
Data retention current	I <sub>DR</sub>	Vcc=3.0V, $\overline{\text{CS}} \geq V_{\text{cc}} - 0.2\text{V}^{(1)}$	-	0.5	20	μA
Data retention set-up time	t <sub>SDR</sub>	See data retention waveform	0	-	-	ms
Recovery time	t <sub>RDR</sub>		5	-	-	

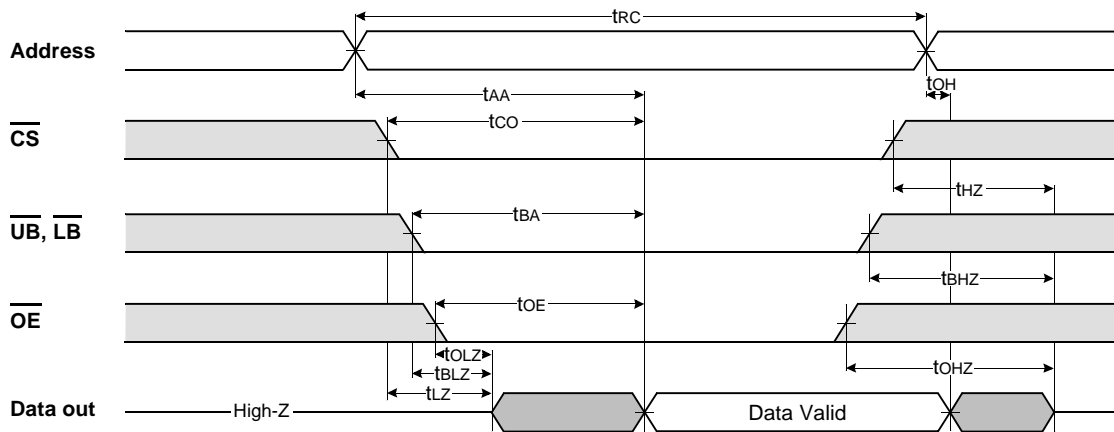
1.  $\overline{\text{CS}} \geq V_{\text{cc}} - 0.2\text{V}$  ( $\overline{\text{CS}}$  controlled) or  $\overline{\text{LB}} = \overline{\text{UB}} \geq V_{\text{cc}} - 0.2\text{V}$ ,  $\overline{\text{CS}} \leq 0.2\text{V}$  ( $\overline{\text{LB}}$ ,  $\overline{\text{UB}}$  controlled)

## TIMMING DIAGRAMS

**TIMING WAVEFORM OF READ CYCLE(1)** (Address Controlled,  $\overline{CS}=\overline{OE}=V_{IL}$ ,  $\overline{WE}=V_{IH}$ ,  $\overline{UB}$  or/and  $\overline{LB}=V_{IL}$ )



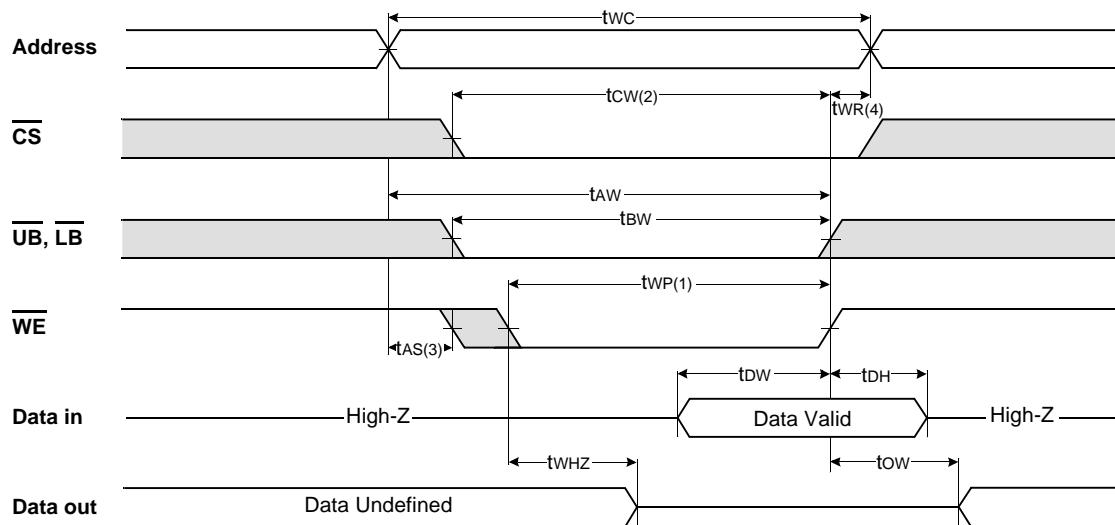
**TIMING WAVEFORM OF READ CYCLE(2)** ( $\overline{WE}=V_{IH}$ )



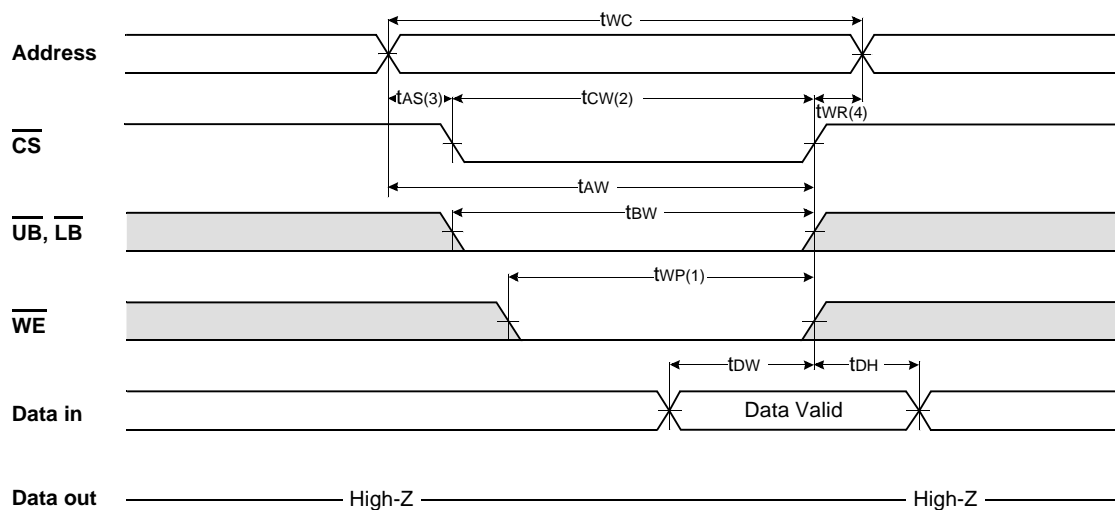
### NOTES (READ CYCLE)

1.  $t_{HZ}$  and  $t_{OHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
2. At any given temperature and voltage condition,  $t_{HZ}(\text{Max.})$  is less than  $t_{LZ}(\text{Min.})$  both for a given device and from device to device interconnection.

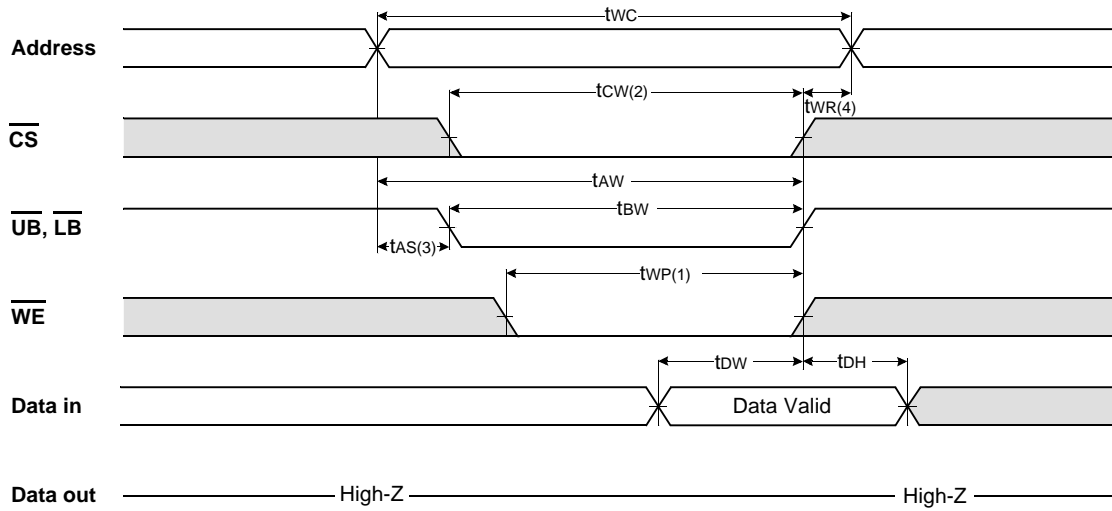
**TIMING WAVEFORM OF WRITE CYCLE(1) ( $\overline{\text{WE}}$  Controlled)**



**TIMING WAVEFORM OF WRITE CYCLE(2) ( $\overline{\text{CS}}$  Controlled)**



## TIMING WAVEFORM OF WRITE CYCLE(3) ( $\overline{UB}$ , $\overline{LB}$ Controlled)

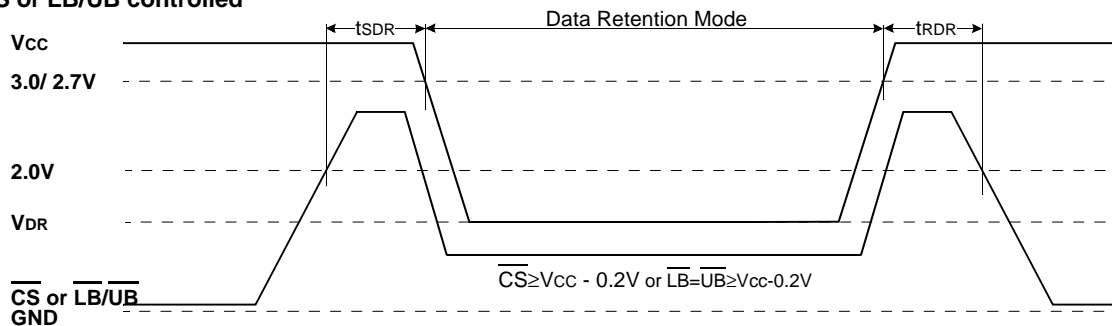


### NOTES (WRITE CYCLE)

1. A write occurs during the overlap( $t_{WP}$ ) of low  $\overline{CS}$  and low  $\overline{WE}$ . A write begins when  $\overline{CS}$  goes low and  $\overline{WE}$  goes low with asserting  $\overline{UB}$  or  $\overline{LB}$  for single byte operation or simultaneously asserting  $\overline{UB}$  and  $\overline{LB}$  for double byte operation. A write ends at the earliest transition when  $\overline{CS}$  goes high and  $\overline{WE}$  goes high. The  $t_{WP}$  is measured from the beginning of write to the end of write.
2.  $t_{CW}$  is measured from the  $\overline{CS}$  going low to end of write.
3.  $t_{AS}$  is measured from the address valid to the beginning of write.
4.  $t_{WR}$  is measured from the end of write to the address change.  $t_{WR}$  applied in case a write ends as  $\overline{CS}$  or  $\overline{WE}$  going high.

## DATA RETENTION WAVE FORM

### $\overline{CS}$ or $\overline{LB}/\overline{UB}$ controlled





## PACKAGE DIMENSIONS

Units : millimeter

