

Document Title

256Kx16 bit Low Power and Low Voltage CMOS Static RAM

Revision History

<u>Revision No.</u>	<u>History</u>	<u>Draft Date</u>	<u>Remark</u>
0.0	Initial draft	July 4, 1998	Preliminary
0.01	Errata correction	August 17, 1998	
1.0	Finalize - Specified CSP type. - Errata correction	November 16, 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
KM616U4110C Family: 2.7~3.3V
- Low Data Retention Voltage: 2.0V(Min)
- Three state output and TTL Compatible
- Dual CS and standby control by UB, LB
- Package Type: 48-μBGA with 0.75mm ball pitch

GENERAL DESCRIPTION

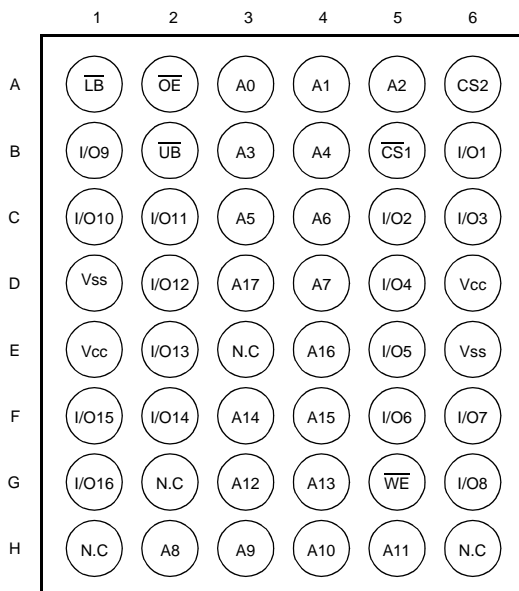
The KM616U4110C families are fabricated by SAMSUNG's advanced CMOS process technology. The families support industrial operating temperature ranges and have chip scale package for user flexibility of system design. The families also support low data retention voltage for battery back-up operation with low data retention current.

PRODUCT FAMILY

Product Family	Operating Temperature	Vcc Range	Speed(ns)	Power Dissipation		PKG Type
				Standby (Isb1, Max)	Operating (Icc2, Max)	
KM616U4110CLI-L	Industrial(-40~85°C)	2.7~3.3V	70 ¹⁾ /85/100	20μA	45mA	48-μBGA

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

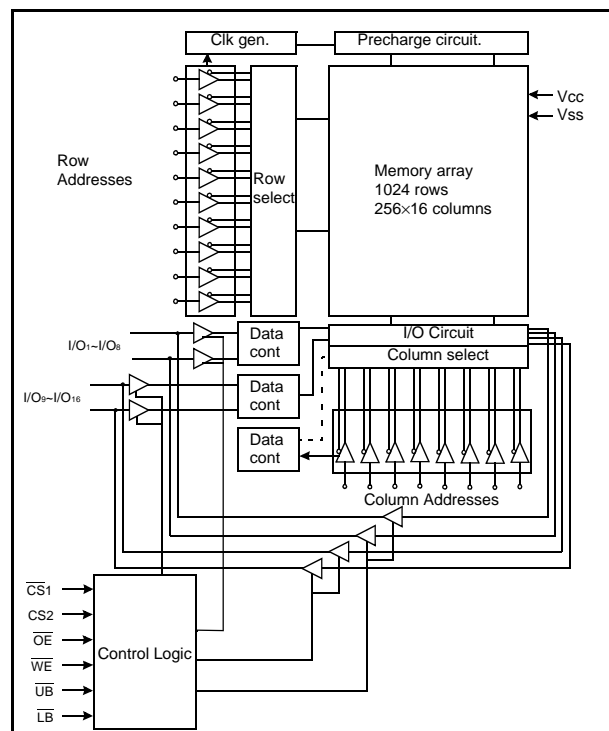
PIN DESCRIPTION



48-ball CSP - Top View (Ball Down)

Name	Function	Name	Function
CS1, CS2	Chip Select Inputs	Vcc	Power
OE	Output Enable Input	Vss	Ground
WE	Write Enable Input	UB	Upper Byte(I/O9~16)
A0~A17	Address Inputs	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
KM616U4110CLZI-7L	48-μBGA, 70ns, 3.0V, LL
KM616U4110CLZI-8L	48-μBGA, 85ns, 3.0V, LL
KM616U4110CLZI-10L	48-μBGA, 100ns, 3.0V, LL

FUNCTIONAL DESCRIPTION

\overline{CS}_1	CS_2	\overline{OE}	\overline{WE}	\overline{LB}	\overline{UB}	I/O ₁₋₈	I/O ₉₋₁₆	Mode	Power
H	X ¹⁾	X ¹⁾	X ¹⁾	X ¹⁾	X ¹⁾	High-Z	High-Z	Deselected	Standby
X ¹⁾	L	X ¹⁾	X ¹⁾	X ¹⁾	X ¹⁾	High-Z	High-Z	Deselected	Standby
X ¹⁾	X ¹⁾	X ¹⁾	X ¹⁾	H	H	High-Z	High-Z	Deselected	Standby
L	H	H	H	L	X ¹⁾	High-Z	High-Z	Output Disabled	Active
L	H	H	H	X ¹⁾	L	High-Z	High-Z	Output Disabled	Active
L	H	L	H	L	H	Dout	High-Z	Lower Byte Read	Active
L	H	L	H	H	L	High-Z	Dout	Upper Byte Read	Active
L	H	L	H	L	L	Dout	Dout	Word Read	Active
L	H	X ¹⁾	L	L	H	Din	High-Z	Lower Byte Write	Active
L	H	X ¹⁾	L	H	L	High-Z	Din	Upper Byte Write	Active
L	H	X ¹⁾	L	L	L	Din	Din	Word Write	Active

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

ABSOLUTE MAXIMUM RATINGS¹⁾

Item	Symbol	Ratings	Unit
Voltage on any pin relative to Vss	V _{IN} , V _{OUT}	-0.5 to V _{CC} +0.5	V
Voltage on Vcc supply relative to Vss	V _{CC}	-0.3 to 4.6	V
Power Dissipation	P _D	1.0	W
Storage temperature	T _{STG}	-65 to 150	°C
Operating Temperature	T _A	-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 CONDITIONS¹⁾

Item	Symbol	Product	Min	Typ	Max	Unit
Supply voltage	V _{CC}	KM616U4110C Family	2.7	3.0	3.3	V
Ground	V _{SS}	KM616U4110C Family	0	0	0	V
Input high voltage	V _{IH}	KM616U4110C Family	2.2	-	V _{CC} +0.3 ²⁾	V
Input low voltage	V _{IL}	KM616U4110C Family	-0.3 ³⁾	-	0.6	V

Note:

1. T_A= -40 to 85°C, otherwise specified

2. Overshoot: V_{CC}+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.

CAPACITANCE¹⁾ (f=1MHz, T_A=25°C)

Item	Symbol	Test Condition	Min	Max	Unit
Input capacitance	C _{IN}	V _{IN} =0V	-	8	pF
Input/Output capacitance	C _{IO}	V _{IO} =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 _{LI}	V _{IN} =V _{SS} to V _{CC}	-1	-	1	μA
Output leakage current	I _{LO}	$\overline{CS}_1=V_{IH}$, CS ₂ =V _{IL} or $\overline{OE}=V_{IH}$ or $\overline{WE}=V_{IL}$, V _{IO} =V _{SS} to V _{CC}	-1	-	1	μA
Operating power supply current	I _{CC}	I _{IO} =0mA, $\overline{CS}_1=V_{IL}$, CS ₂ =V _{IH} , V _{IN} =V _{IH} or V _{IL}	-	-	4	mA
Average operating current	I _{CC1}	Cycle time=1μs, 100%duty, I _{IO} =0mA, $\overline{CS}_1 \leq 0.2V$, CS ₂ ≥V _{CC} -0.2V, V _{IN} ≤0.2V or V _{IN} ≥V _{CC} -0.2V	-	-	6	mA
	I _{CC2}	Cycle time=Min, I _{IO} =0mA, 100% duty, $\overline{CS}_1=V_{IL}$, CS ₂ =V _{IH} , V _{IN} =V _{IL} or V _{IH}	-	-	45	mA
Output low voltage	V _{OL}	I _{OL} = 2.1mA			0.4	V
Output high voltage	V _{OH}	I _{OH} = -1.0mA	2.2			V
Standby Current(TTL)	I _{SB}	$\overline{CS}_1=V_{IH}$, CS ₂ =V _{IL} , Other inputs=V _{IH} or V _{IL}	-	-	0.3	mA
Standby Current(CMOS)	I _{SB1}	$\overline{CS}_1 \geq V_{CC}-0.2V$, CS ₂ ≥V _{CC} -0.2V(\overline{CS}_1 controlled) or CS ₂ ≤0.2V(CS ₂ controlled), Other inputs=0~V _{CC}	-	-	20	μA

AC OPERATING CONDITIONS

TEST CONDITIONS (Test Load and Input/Output Reference)

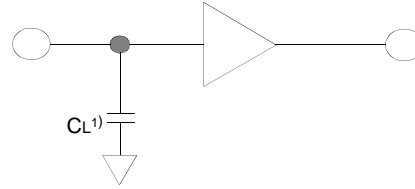
Input pulse level: 0.4 to 2.2V

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 ($V_{CC}=2.7\sim 3.3\text{V}$, $T_A=-40$ to 85°C)

Parameter List		Symbol	Speed Bins						Units
			70ns		85ns		100ns		
			Min	Max	Min	Max	Min	Max	
Read	Read cycle time	tRC	70	-	85	-	100	-	ns
	Address access time	tAA	-	70	-	85	-	100	ns
	Chip select to output	tCO	-	70	-	85	-	100	ns
	Output enable to valid output	tOE	-	35	-	40	-	50	ns
	$\overline{\text{LB}}$, $\overline{\text{UB}}$ valid to data output	tBA	-	70	-	85	-	100	ns
	Chip select to low-Z output	tLZ	10	-	10	-	10	-	ns
	Output enable to low-Z output	tOLZ	5	-	5	-	5	-	ns
	$\overline{\text{LB}}$, $\overline{\text{UB}}$ enable to low-Z output	tBLZ	10	-	10	-	10	-	ns
	Output hold from address change	tOH	10	-	10	-	15	-	ns
	Chip disable to high-Z output	tHZ	0	25	0	25	0	30	ns
	$\overline{\text{OE}}$ disable to high-Z output	tOHZ	0	25	0	25	0	30	ns
	$\overline{\text{UB}}$, $\overline{\text{LB}}$ disable to high-Z output	tBHZ	0	25	0	25	0	30	ns
Write	Write cycle time	tWC	70	-	85	-	100	-	ns
	Chip select to end of write	tCW	60	-	70	-	80	-	ns
	Address set-up time	tAS	0	-	0	-	0	-	ns
	Address valid to end of write	tAW	60	-	70	-	80	-	ns
	Write pulse width	tWP	55	-	60	-	70	-	ns
	Write recovery time	tWR	0	-	0	-	0	-	ns
	Write to output high-Z	tWHZ	0	25	0	25	0	30	ns
	Data to write time overlap	tDW	30	-	35	-	40	-	ns
	Data hold from write time	tDH	0	-	0	-	0	-	ns
	End write to output low-Z	tOW	5	-	5	-	5	-	ns
	$\overline{\text{LB}}$, $\overline{\text{UB}}$ valid to end of write	tBW	60	-	70	-	80	-	ns

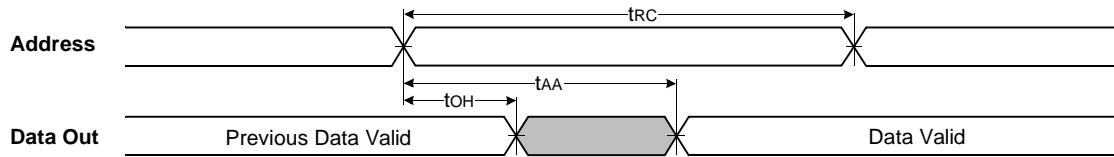
DATA RETENTION CHARACTERISTICS

Item	Symbol	Test Condition	Min	Typ	Max	Unit
V _{CC} for data retention	V _{DR}	$\overline{\text{CS}}_1 \geq V_{CC}-0.2\text{V}^{1)}$	2.0	-	3.3	V
Data retention current	I _{DR}	$V_{CC}=3.0\text{V}$, $\overline{\text{CS}}_1 \geq V_{CC}-0.2\text{V}^{1)}$	-	0.5	20	μA
Data retention set-up time	t _{SDR}	See data retention waveform	0	-	-	ms
Recovery time	t _{RDR}		5	-	-	

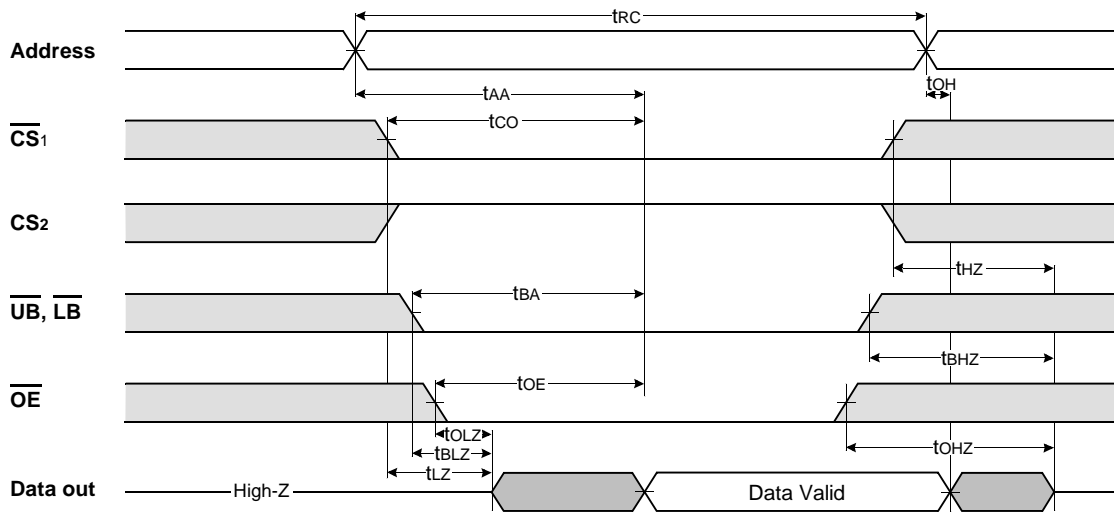
1. $\overline{\text{CS}}_1 \geq V_{CC}-0.2\text{V}$, $\overline{\text{CS}}_2 \geq V_{CC}-0.2\text{V}$ ($\overline{\text{CS}}_1$ controlled) or $\overline{\text{CS}}_2 \geq V_{CC}-0.2\text{V}$ ($\overline{\text{CS}}_2$ controlled)

TIMMING DIAGRAMS

TIMING WAVEFORM OF READ CYCLE(1) (Address Controlled, $\overline{CS1}=\overline{OE}=V_{IL}$, $CS2=\overline{WE}=V_{IH}$, \overline{UB} or/and $\overline{LB}=V_{IL}$)



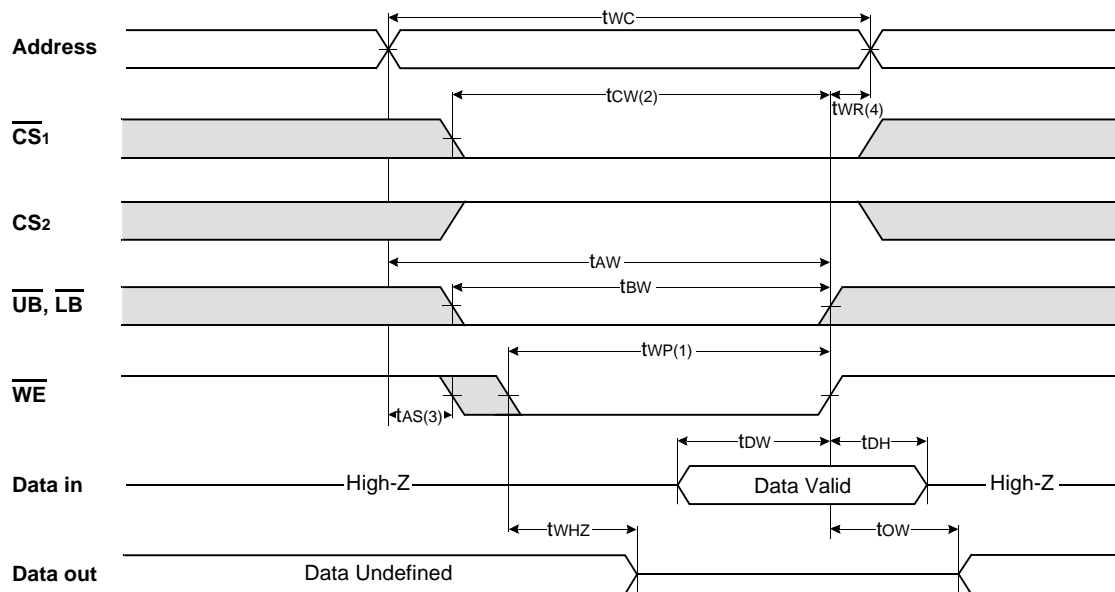
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE}=V_{IH}$)



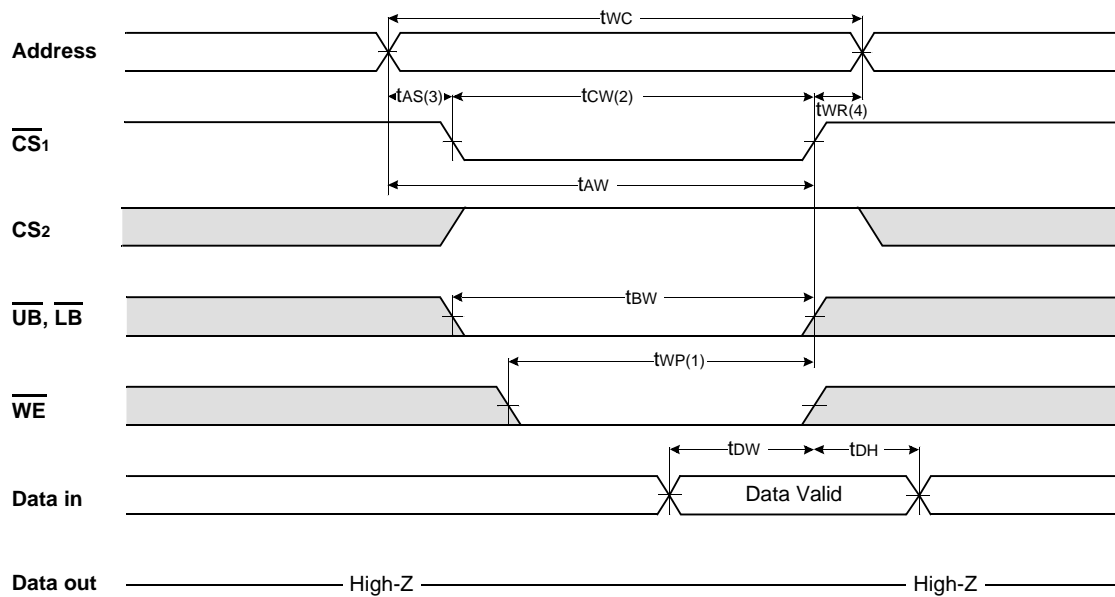
NOTES (READ CYCLE)

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.

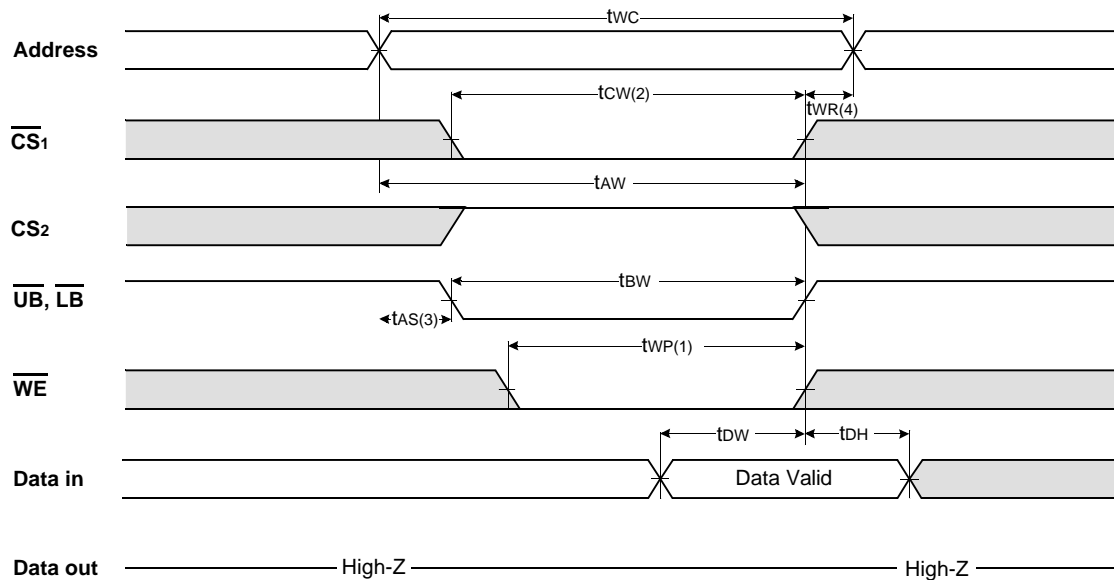
TIMING WAVEFORM OF WRITE CYCLE(1) ($\overline{\text{WE}}$ Controlled)



TIMING WAVEFORM OF WRITE CYCLE(2) ($\overline{\text{CS}}_1$ Controlled)



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

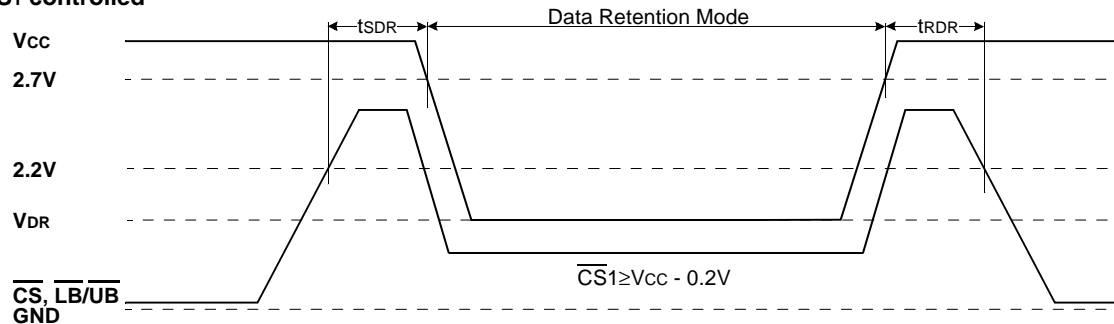


NOTES (WRITE CYCLE)

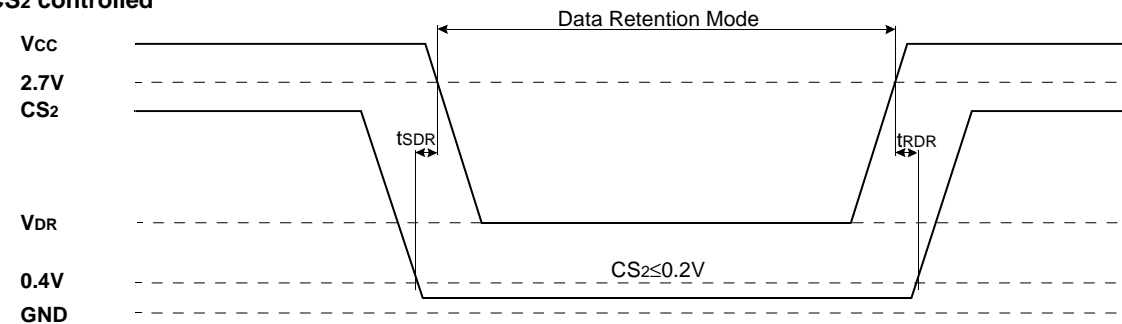
1. A write occurs during the overlap(t_{WP}) of low $\overline{CS1}$ and low \overline{WE} . A write begins when $\overline{CS1}$ goes low and \overline{WE} goes low with asserting \overline{UB} or \overline{LB} for single byte operation or simultaneously asserting \overline{UB} and \overline{LB} for double byte operation. A write ends at the earliest transition when $\overline{CS1}$ 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 $\overline{CS1}$ 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 $\overline{CS1}$ or \overline{WE} going high.

DATA RETENTION WAVE FORM

$\overline{CS1}$ controlled



$CS2$ controlled



PACKAGE DIMENSIONS

Units : millimeter

48 BALL MICRO BALL GRID ARRAY- 0.75mm ball pitch

