

**Document Title**

256Kx4 Bit (with OE) High-Speed CMOS Static RAM(3.3V Operating).

**Revision History**

<b>Rev.No.</b>	<b>History</b>	<b>Draft Data</b>	<b>Remark</b>																			
Rev. 0.0	Initial release with Preliminary.	Aug. 5th. 1998	Preliminary																			
Rev. 1.0	Release to Final Data Sheet. 1.1. Delete Preliminary. 1.2. Relax DC characteristics.	Sep. 7th. 1998	Final																			
	<table border="1"> <thead> <tr> <th>Item</th> <th>Previous</th> <th>Changed</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Icc</td> <td>12ns</td> <td>65mA</td> </tr> <tr> <td>15ns</td> <td>63mA</td> </tr> <tr> <td>20ns</td> <td>60mA</td> </tr> </tbody> </table>	Item	Previous	Changed	Icc	12ns	65mA	15ns	63mA	20ns	60mA											
Item	Previous	Changed																				
Icc	12ns	65mA																				
	15ns	63mA																				
	20ns	60mA																				
Rev. 2.0	Add 10ns & Low Power Ver.	Apr. 24. 2000	Final																			
Rev. 2.1	V <sub>IH</sub> /V <sub>IL</sub> Change	Oct. 2. 2000	Final																			
	<table border="1"> <thead> <tr> <th rowspan="2">Item</th> <th colspan="2">Previous</th> <th colspan="2">Changed</th> </tr> <tr> <th>Min</th> <th>Max</th> <th>Min</th> <th>Max</th> </tr> </thead> <tbody> <tr> <td>V<sub>IH</sub></td> <td>2.2</td> <td>V<sub>CC</sub>+0.5</td> <td>2.0</td> <td>V<sub>CC</sub>+0.3</td> </tr> <tr> <td>V<sub>IL</sub></td> <td>-0.5</td> <td>0.8</td> <td>-0.3</td> <td>0.8</td> </tr> </tbody> </table>	Item	Previous		Changed		Min	Max	Min	Max	V <sub>IH</sub>	2.2	V <sub>CC</sub> +0.5	2.0	V <sub>CC</sub> +0.3	V <sub>IL</sub>	-0.5	0.8	-0.3	0.8		
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V <sub>IH</sub>	2.2	V <sub>CC</sub> +0.5	2.0	V <sub>CC</sub> +0.3																		
V <sub>IL</sub>	-0.5	0.8	-0.3	0.8																		
Rev.3.0	Delete 20ns speed bin	Sep. 24. 2001	Final																			

The attached data sheets are prepared and approved by SAMSUNG Electronics. SAMSUNG Electronics CO., LTD. reserve the right to change the specifications. SAMSUNG Electronics will evaluate and reply to your requests and questions on the parameters of this device. If you have any questions, please contact the SAMSUNG branch office near your office, call or contact Headquarters.

## 256K x 4 Bit (with OE) High-Speed CMOS Static RAM(3.3V Operating)

### FEATURES

- Fast Access Time 10,12,15ns(Max.)
- Low Power Dissipation
  - Standby (TTL) : 30mA(Max.)
  - (CMOS) : 5mA(Max.)
  - 0.5mA(Max.) L-Ver. only
- Operating K6R1004V1C-10 : 75mA(Max.)
- K6R1004V1C-12 : 70mA(Max.)
- K6R1004V1C-15 : 68mA(Max.)
- Single 3.3±0.3V Power Supply
- TTL Compatible Inputs and Outputs
- Fully Static Operation
  - No Clock or Refresh required
- Three State Outputs
- 2V Minimum Data Retention : L-ver. Only
- Center Power/Ground Pin Configuration
- Standard Pin Configuration :
  - K6R1004V1C-J : 32-SOJ-400

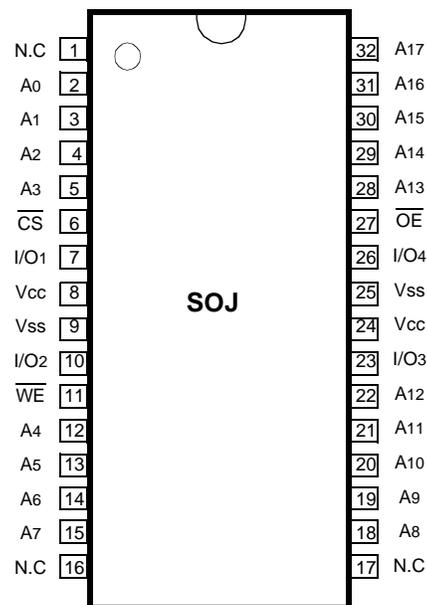
### GENERAL DESCRIPTION

The K6R1004V1C is a 1,048,576-bit high-speed Static Random Access Memory organized as 262,144 words by 4 bits. The K6R1004V1C uses 4 common input and output lines and has an output enable pin which operates faster than address access time at read cycle. The device is fabricated using SAMSUNG's advanced CMOS process and designed for high-speed circuit technology. It is particularly well suited for use in high-density high-speed system applications. The K6R1004V1C is packaged in a 400 mil 32-pin plastic SOJ.

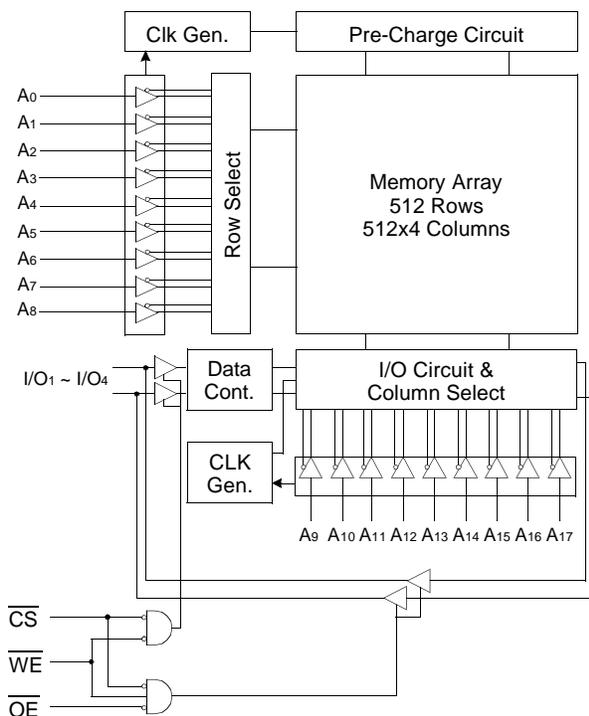
### ORDERING INFORMATION

K6R1004V1C-C10/C12/C15	Commercial Temp.
K6R1004V1C-I10/I12/I15	Industrial Temp.

### PIN CONFIGURATION (Top View)



### FUNCTIONAL BLOCK DIAGRAM



### PIN FUNCTION

Pin Name	Pin Function
A0 - A17	Address Inputs
$\overline{WE}$	Write Enable
$\overline{CS}$	Chip Select
$\overline{OE}$	Output Enable
I/O1 ~ I/O4	Data Inputs/Outputs
Vcc	Power(+3.3V)
Vss	Ground
N.C	No Connection

## ABSOLUTE MAXIMUM RATINGS\*

Parameter		Symbol	Rating	Unit
Voltage on Any Pin Relative to Vss		V <sub>IN</sub> , V <sub>OUT</sub>	-0.5 to 4.6	V
Voltage on Vcc Supply Relative to Vss		V <sub>CC</sub>	-0.5 to 4.6	V
Power Dissipation		P <sub>d</sub>	1	W
Storage Temperature		T <sub>STG</sub>	-65 to 150	°C
Operating Temperature	Commercial	T <sub>A</sub>	0 to 70	°C
	Industrial	T <sub>A</sub>	-40 to 85	°C

\* 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 at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

RECOMMENDED DC OPERATING CONDITIONS(T<sub>A</sub>=0 to 70°C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V <sub>CC</sub>	3.0	3.3	3.6	V
Ground	V <sub>SS</sub>	0	0	0	V
Input High Voltage	V <sub>IH</sub>	2.0	-	V <sub>CC</sub> +0.3**	V
Input Low Voltage	V <sub>IL</sub>	-0.3*	-	0.8	V

\* V<sub>IL</sub>(Min) = -2.0V a.c (Pulse Width ≤ 8ns) for I ≤ 20mA.

\*\* V<sub>IH</sub>(Max) = V<sub>CC</sub> + 2.0V a.c (Pulse Width ≤ 8ns) for I ≤ 20mA.

DC AND OPERATING CHARACTERISTICS\*(T<sub>A</sub>=0 to 70°C, V<sub>CC</sub>=3.3±0.3V, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Max	Unit	
Input Leakage Current	I <sub>LI</sub>	V <sub>IN</sub> = V <sub>SS</sub> to V <sub>CC</sub>	-2	2	μA	
Output Leakage Current	I <sub>LO</sub>	$\overline{CS}=V_{IH}$ or $\overline{OE}=V_{IH}$ or $\overline{WE}=V_{IL}$ V <sub>OUT</sub> =V <sub>SS</sub> to V <sub>CC</sub>	-2	2	μA	
Operating Current	I <sub>CC</sub>	Min. Cycle, 100% Duty $\overline{CS}=V_{IL}$ , V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OUT</sub> =0mA	10ns	-	75	mA
			12ns	-	70	
			15ns	-	68	
Standby Current	I <sub>SB</sub>	Min. Cycle, $\overline{CS}=V_{IH}$	-	30	mA	
	I <sub>SB1</sub>	f=0MHz, $\overline{CS} \geq V_{CC}-0.2V$ , V <sub>IN</sub> ≥V <sub>CC</sub> -0.2V or V <sub>IN</sub> ≤0.2V	Normal	-		5
L-ver.			-	0.5		
Output Low Voltage Level	V <sub>OL</sub>	I <sub>OL</sub> =8mA	-	0.4	V	
Output High Voltage Level	V <sub>OH</sub>	I <sub>OH</sub> =-4mA	2.4	-	V	

\* The above parameters are also guaranteed at industrial temperature range.

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

Item	Symbol	Test Conditions	MIN	Max	Unit
Input/Output Capacitance	C <sub>I/O</sub>	V <sub>I/O</sub> =0V	-	8	pF
Input Capacitance	C <sub>IN</sub>	V <sub>IN</sub> =0V	-	6	pF

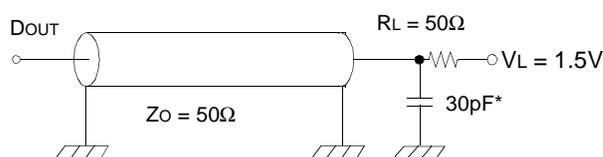
\* Capacitance is sampled and not 100% tested.

## AC CHARACTERISTICS (T<sub>A</sub>=0 to 70°C, V<sub>CC</sub>=3.3±0.3V, unless otherwise noted.)

### TEST CONDITIONS

Parameter	Value
Input Pulse Levels	0V to 3V
Input Rise and Fall Times	3ns
Input and Output timing Reference Levels	1.5V
Output Loads	See below

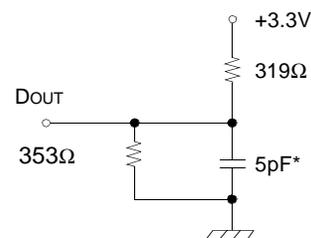
Output Loads(A)



\* Capacitive Load consists of all components of the test environment.

Output Loads(B)

for t<sub>HZ</sub>, t<sub>LZ</sub>, t<sub>WHZ</sub>, t<sub>OW</sub>, t<sub>OLZ</sub> & t<sub>OHZ</sub>



\* Including Scope and Jig Capacitance

### READ CYCLE\*

Parameter	Symbol	K6R1004V1C-10		K6R1004V1C-12		K6R1004V1C-15		Unit
		Min	Max	Min	Max	Min	Max	
Read Cycle Time	t <sub>RC</sub>	10	-	12	-	15	-	ns
Address Access Time	t <sub>AA</sub>	-	10	-	12	-	15	ns
Chip Select to Output	t <sub>CO</sub>	-	10	-	12	-	15	ns
Output Enable to Valid Output	t <sub>OE</sub>	-	5	-	6	-	7	ns
Chip Enable to Low-Z Output	t <sub>LZ</sub>	3	-	3	-	3	-	ns
Output Enable to Low-Z Output	t <sub>OLZ</sub>	0	-	0	-	0	-	ns
Chip Disable to High-Z Output	t <sub>HZ</sub>	0	5	0	6	0	7	ns
Output Disable to High-Z Output	t <sub>OHZ</sub>	0	5	0	6	0	7	ns
Output Hold from Address Change	t <sub>OH</sub>	3	-	3	-	3	-	ns
Chip Selection to Power Up Time	t <sub>PU</sub>	0	-	0	-	0	-	ns
Chip Selection to Power Down Time	t <sub>PD</sub>	-	10	-	12	-	15	ns

\* The above parameters are also guaranteed at industrial temperature range.

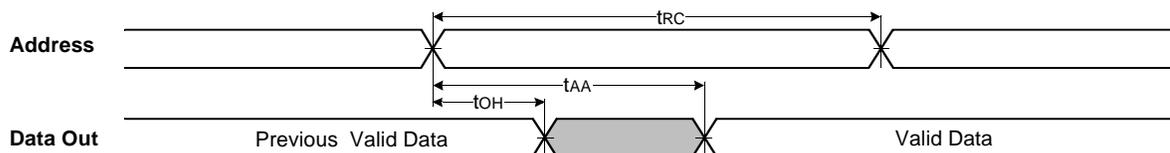
## WRITE CYCLE\*

Parameter	Symbol	K6R1004V1C-10		K6R1004V1C-12		K6R1004V1C-15		Unit
		Min	Max	Min	Max	Min	Max	
Write Cycle Time	tWC	10	-	12	-	15	-	ns
Chip Select to End of Write	tCW	7	-	8	-	9	-	ns
Address Set-up Time	tAS	0	-	0	-	0	-	ns
Address Valid to End of Write	tAW	7	-	8	-	9	-	ns
Write Pulse Width( $\overline{OE}$ High)	tWP	7	-	8	-	9	-	ns
Write Pulse Width( $\overline{OE}$ Low)	tWP1	10	-	12	-	15	-	ns
Write Recovery Time	tWR	0	-	0	-	0	-	ns
Write to Output High-Z	tWHZ	0	5	0	6	0	7	ns
Data to Write Time Overlap	tdW	5	-	6	-	7	-	ns
Data Hold from Write Time	tdH	0	-	0	-	0	-	ns
End Write to Output Low-Z	tOW	3	-	3	-	3	-	ns

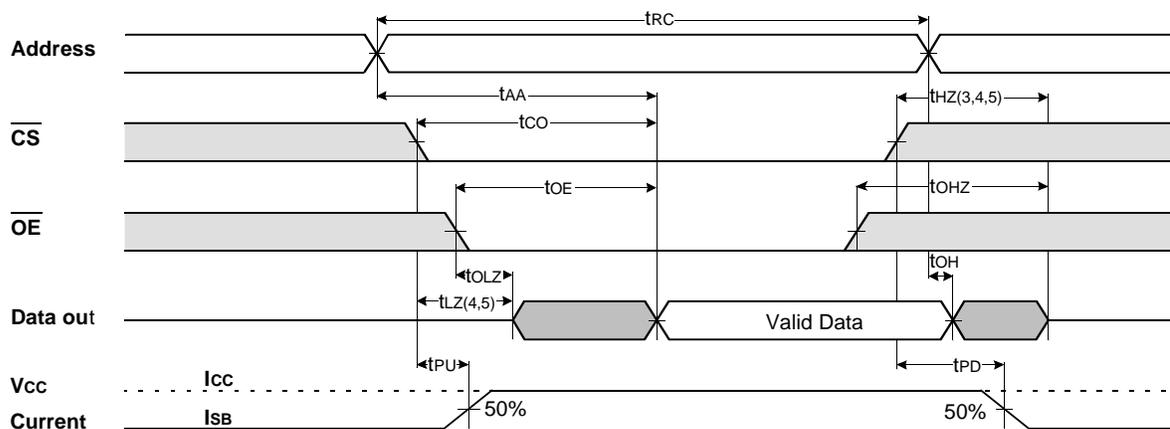
\* The above parameters are also guaranteed at industrial temperature range.

## TIMING DIAGRAMS

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



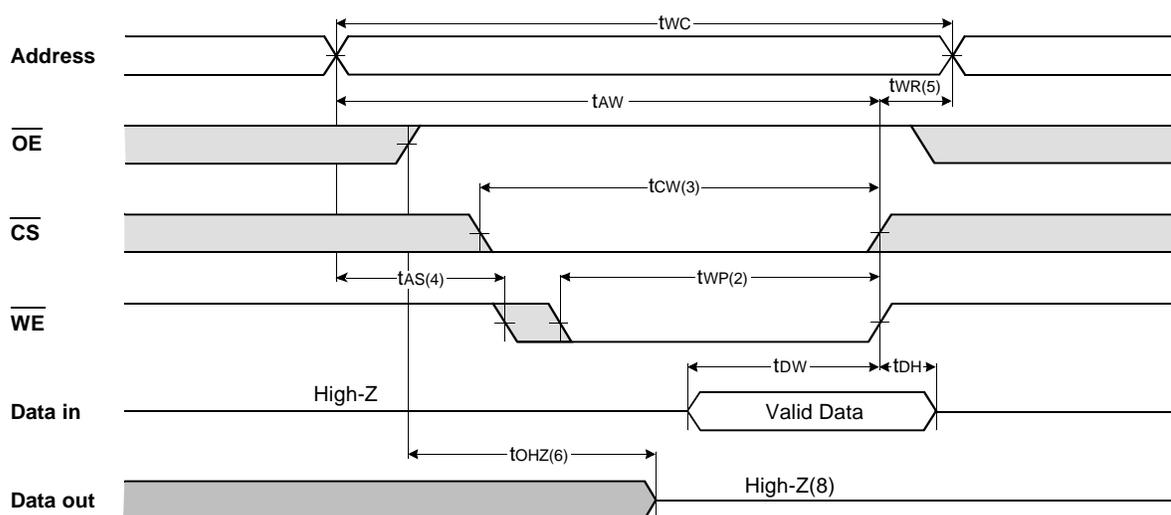
**TIMING WAVEFORM OF READ CYCLE(2)** ( $\overline{WE}=V_{IH}$ )



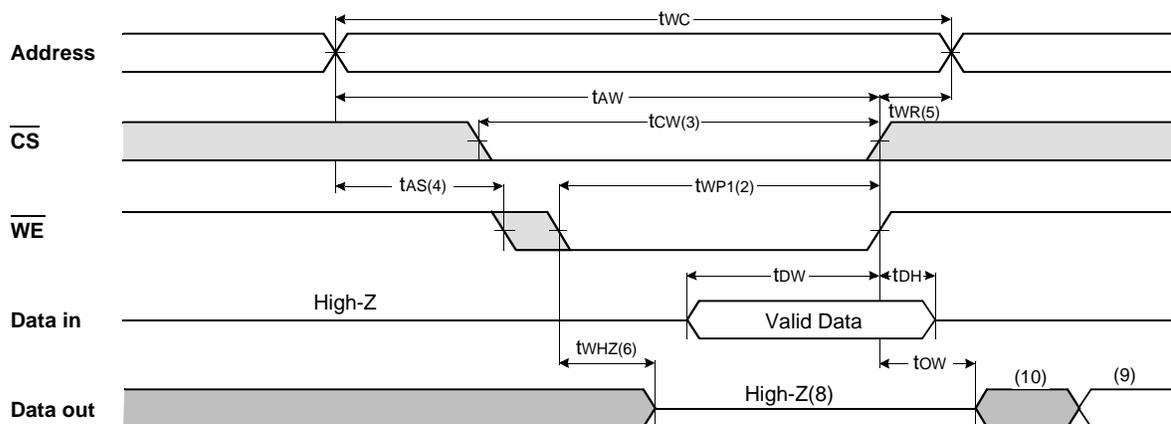
### NOTES(READ CYCLE)

1.  $\overline{WE}$  is high for read cycle.
2. All read cycle timing is referenced from the last valid address to the first transition address.
3.  $t_{HZ}$  and  $t_{OH}$  are defined as the time at which the outputs achieve the open circuit condition and are not referenced to  $V_{OH}$  or  $V_{OL}$  levels.
4. 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.
5. Transition is measured  $\pm 200\text{mV}$  from steady state voltage with Load(B). This parameter is sampled and not 100% tested.
6. Device is continuously selected with  $\overline{CS}=V_{IL}$ .
7. Address valid prior to coincident with  $\overline{CS}$  transition low.
8. For common I/O applications, minimization or elimination of bus contention conditions is necessary during read and write cycle.

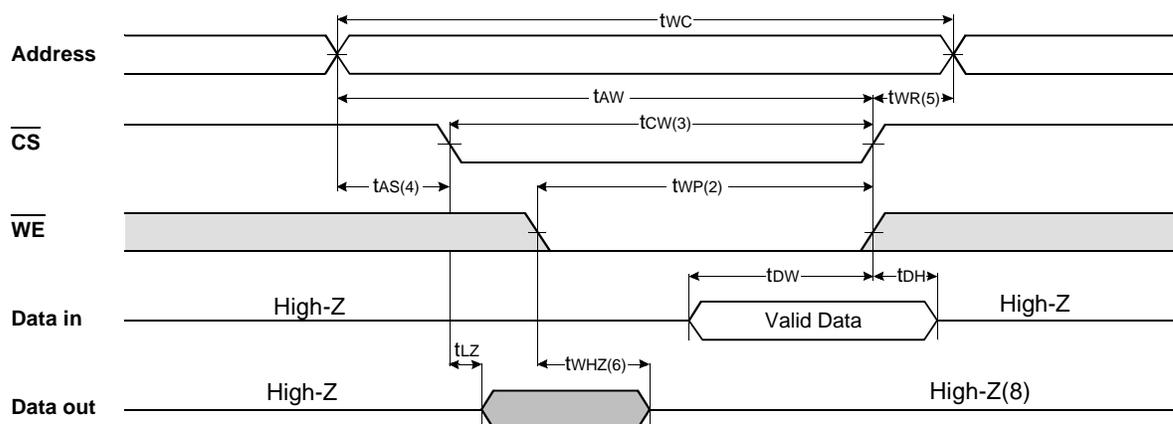
### TIMING WAVEFORM OF WRITE CYCLE(1) ( $\overline{OE}$ = Clock)



### TIMING WAVEFORM OF WRITE CYCLE(2) ( $\overline{OE}$ =Low Fixed)



TIMING WAVEFORM OF WRITE CYCLE(3) ( $\overline{CS}$ =Controlled)



NOTES(WRITE CYCLE)

1. All write cycle timing is referenced from the last valid address to the first transition address.
2. A write occurs during the overlap of a low  $\overline{CS}$  and  $\overline{WE}$ . A write begins at the latest transition  $\overline{CS}$  going low and  $\overline{WE}$  going low ; A write ends at the earliest transition  $\overline{CS}$  going high or  $\overline{WE}$  going high.  $t_{WP}$  is measured from the beginning of write to the end of write.
3.  $t_{CW}$  is measured from the later of  $\overline{CS}$  going low to end of write.
4.  $t_{AS}$  is measured from the address valid to the beginning of write.
5.  $t_{WR}$  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.
6. If  $\overline{OE}$ ,  $\overline{CS}$  and  $\overline{WE}$  are in the Read Mode during this period, the I/O pins are in the output low-Z state. Inputs of opposite phase of the output must not be applied because bus contention can occur.
7. For common I/O applications, minimization or elimination of bus contention conditions is necessary during read and write cycle.
8. If  $\overline{CS}$  goes low simultaneously with  $\overline{WE}$  going or after  $\overline{WE}$  going low, the outputs remain high impedance state.
9. Dout is the read data of the new address.
10. When  $\overline{CS}$  is low : I/O pins are in the output state. The input signals in the opposite phase leading to the output should not be applied.

FUNCTIONAL DESCRIPTION

$\overline{CS}$	$\overline{WE}$	$\overline{OE}$	Mode	I/O Pin	Supply Current
H	X	X*	Not Select	High-Z	$I_{SB}$ , $I_{SB1}$
L	H	H	Output Disable	High-Z	$I_{CC}$
L	H	L	Read	DOUT	$I_{CC}$
L	L	X	Write	DIN	$I_{CC}$

\* X means Don't Care.

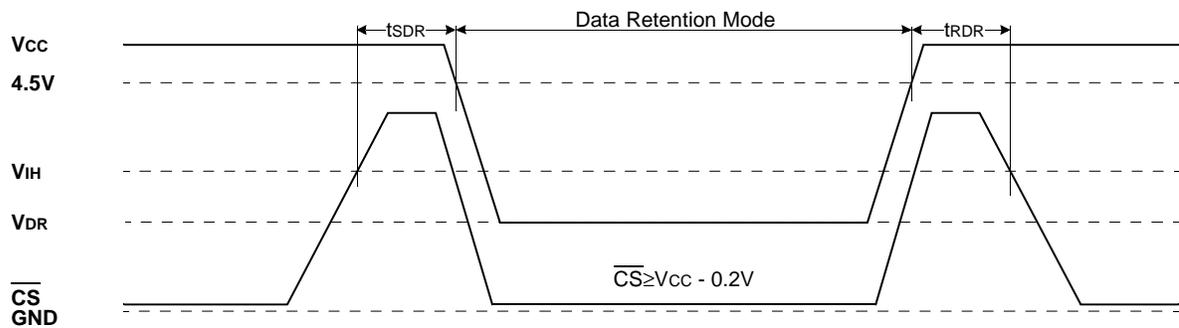
DATA RETENTION CHARACTERISTICS\* (TA=0 to 70°C)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Vcc for Data Retention	VDR	$\overline{CS} \geq V_{cc} - 0.2V$	2.0	-	3.6	V
Data Retention Current	IDR	$V_{cc} = 3.0V, \overline{CS} \geq V_{cc} - 0.2V$ $V_{IN} \geq V_{cc} - 0.2V$ or $V_{IN} \leq 0.2V$	-	-	0.4	mA
		$V_{cc} = 2.0V, \overline{CS} \geq V_{cc} - 0.2V$ $V_{IN} \geq V_{cc} - 0.2V$ or $V_{IN} \leq 0.2V$	-	-	0.3	
Data Retention Set-Up Time	tSDR	See Data Retention Wave form(below)	0	-	-	ns
Recovery Time	tRDR	See Data Retention Wave form(below)	5	-	-	ms

\* The above parameters are also guaranteed at industrial temperature range.  
Data Retention Characteristic is for L-ver only.

DATA RETENTION WAVE FORM

$\overline{CS}$  controlled



PACKAGE DIMENSIONS

Units: millimeters/Inches

32-SOJ-400

