

**Document Title**

**1MKx4 Bit (with OE) High Speed Static RAM(5V Operating), Revolutionary Pin out. Operated at Commercial Temperature Range.**

**Revision History**

<u>RevNo.</u>	<u>History</u>	<u>Draft Data</u>	<u>Remark</u>																					
Rev. 0.0	Initial release with Design Target.	Jun. 14th, 1996	Design Target																					
Rev. 0.5	Release to Preliminary Data Sheet. 0.1. Replace Design Target to Preliminary. 0.2. Delete 12ns part but add 17ns part. 0.3. Relax D.C and A.C parameters and insert new parameter(Icc1) with the test condition. 0.3.1. Insert Icc1 parameter with the test condition as address is increased with binary count. 0.3.2. Relax D.C and A.C parameters.	Sep. 16th, 1996	Preliminary																					
	<table border="1"> <thead> <tr> <th>Items</th> <th>Previous spec. (15/ - /20ns part)</th> <th>Relaxed spec. (15/17/20ns part)</th> </tr> </thead> <tbody> <tr> <td>Icc</td> <td>170/ - /160mA</td> <td>200/195/190mA</td> </tr> <tr> <td>tCW</td> <td>10/ - /12ns</td> <td>12/13/14ns</td> </tr> <tr> <td>tAW</td> <td>10/ - /12ns</td> <td>12/13/14ns</td> </tr> <tr> <td>tWP(OE=H)</td> <td>10/ - /12ns</td> <td>12/13/14ns</td> </tr> <tr> <td>tWP1(OE=L)</td> <td>12/ - /14ns</td> <td>15/17/20ns</td> </tr> <tr> <td>tdw</td> <td>7/ - /9ns</td> <td>8/9/10ns</td> </tr> </tbody> </table>	Items	Previous spec. (15/ - /20ns part)	Relaxed spec. (15/17/20ns part)	Icc	170/ - /160mA	200/195/190mA	tCW	10/ - /12ns	12/13/14ns	tAW	10/ - /12ns	12/13/14ns	tWP(OE=H)	10/ - /12ns	12/13/14ns	tWP1(OE=L)	12/ - /14ns	15/17/20ns	tdw	7/ - /9ns	8/9/10ns	Jun. 5th, 1997	Final
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Rev. 1.0	Release to Final Data Sheet. 1.1. Delete Preliminary. 1.2. Delete Icc1 parameter with the test condition. 1.3. Update D.C parameters.																							
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	1.4. Add the test condition for VOH1 with Vcc=5V±5% at 25°C 1.5. Add timing diagram to define tWP as "(Timing Wave Form of Write Cycle(CS=Low fixed))"																							
Rev. 2.0	2.1 Add extended and industrial temperature range parts.	Feb. 25th, 1998	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.



## 1M x 4 Bit (with OE) High-Speed CMOS Static RAM

### FEATURES

- Fast Access Time 15,17,20ns(Max.)
- Low Power Dissipation
  - Standby (TTL) : 50mA(Max.)
  - (CMOS) : 10mA(Max.)
  - Operating KM644002A - 15 : 150mA(Max.)
  - KM644002A - 17 : 145mA(Max.)
  - KM644002A - 20 : 140mA(Max.)
- Single 5.0V±10% Power Supply
- TTL Compatible Inputs and Outputs
- I/O Compatible with 3.3V Device
- Fully Static Operation
  - No Clock or Refresh required
- Three State Outputs
- Center Power/Ground Pin Configuration
- Standard Pin Configuration
  - KM644002AJ : 32-SOJ-400

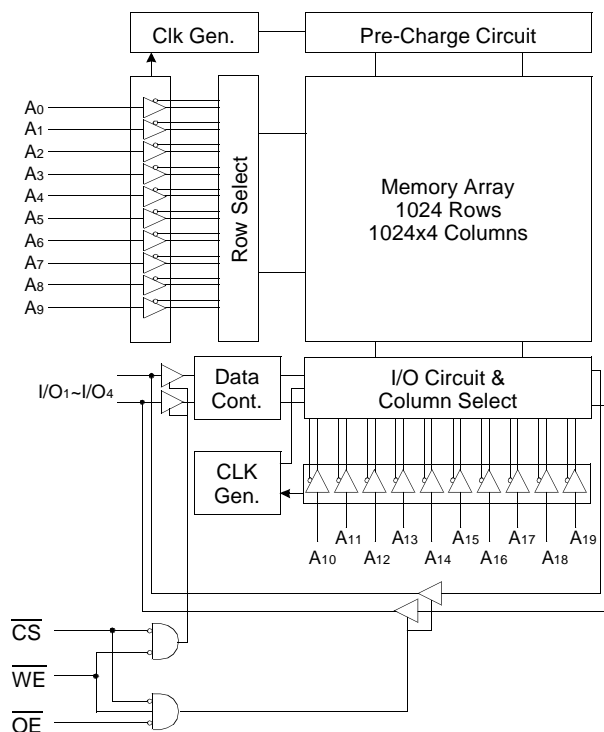
### GENERAL DESCRIPTION

The KM644002A is a 4,194,304-bit high-speed Static Random Access Memory organized as 1,048,576 words by 4 bits. The KM644002A 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 KM644002A is packaged in a 400 mil 32-pin plastic SOJ.

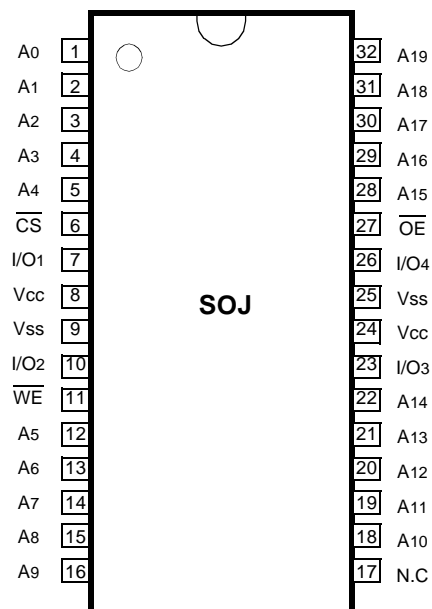
### ORDERING INFORMATION

KM644002A-15/17/20	Commercial Temp.
KM644002AE-15/17/20	Extended Temp.
KM644002AI-15/17/20	Industrial Temp.

### FUNCTIONAL BLOCK DIAGRAM



### PIN CONFIGURATION (Top View)



### PIN FUNCTION

Pin Name	Pin Function
A0 - A19	Address Inputs
$\overline{WE}$	Write Enable
$\overline{CS}$	Chip Select
$\overline{OE}$	Output Enable
I/O1 ~ I/O4	Data Inputs/Outputs
Vcc	Power(+5.0V)
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 7.0	V
Voltage on Vcc Supply Relative to Vss		V <sub>CC</sub>	-0.5 to 7.0	V
Power Dissipation		P <sub>D</sub>	1.0	W
Storage Temperature		T <sub>STG</sub>	-65 to 150	°C
Operating Temperature	Commercial	T <sub>A</sub>	0 to 70	°C
	Extended	T <sub>A</sub>	-25 to 85	°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>	4.5	5.0	5.5	V
Ground	V <sub>SS</sub>	0	0	0	V
Input High Voltage	V <sub>IH</sub>	2.2	-	V <sub>CC</sub> +0.5**	V
Input Low Voltage	V <sub>IL</sub>	-0.5*	-	0.8	V

NOTE: The above parameters are also guaranteed at extended and industrial temperature ranges.

\* V<sub>IL</sub>(Min) = -2.0V a.c(Pulse Width ≤ 10ns) for I ≤ 20mA

\*\* V<sub>IH</sub>(Max) = V<sub>CC</sub> + 2.0V a.c (Pulse Width ≤ 10ns) for I ≤ 20mA

**DC AND OPERATING CHARACTERISTICS**(T<sub>A</sub>=0 to 70°C, V<sub>CC</sub>=5.0V±10%, 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 CS=V <sub>IL</sub> , V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OUT</sub> =0mA	15ns	-	150	mA
			17ns	-	145	
			20ns	-	140	
Standby Current	I <sub>SB</sub>	Min. Cycle, $\overline{CS}=V_{IH}$	-	50	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	-	10	mA	
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	
	V <sub>OH1</sub> *	I <sub>OH1</sub> =-100μA	-	3.95		

NOTE: The above parameters are also guaranteed at extended and industrial temperature ranges.

\* V<sub>CC</sub>=5.0V, Temp.=25°C

**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	-	7	pF

\* NOTE:Capacitance is sampled and not 100% tested.

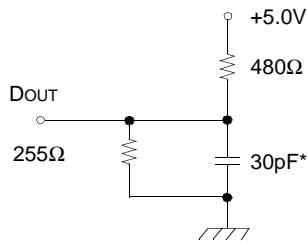
## AC CHARACTERISTICS (TA=0 to 70°C, VCC=5.0V±10%, unless otherwise noted.)

### 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

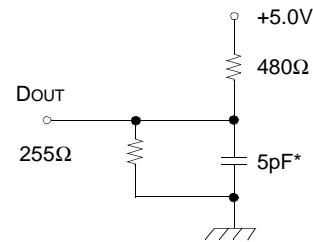
NOTE: The above parameters are also guaranteed at extended and industrial temperature ranges.

Output Loads(A)



Output Loads(B)

for tHZ, tLZ, tWHZ, tOW, tOLZ & tOHZ



\* Including Scope and Jig Capacitance

### READ CYCLE

Parameter	Symbol	KM644002A-15		KM644002A-17		KM644002A-20		Unit
		Min	Max	Min	Max	Min	Max	
Read Cycle Time	tRC	15	-	17	-	20	-	ns
Address Access Time	tAA	-	15	-	17	-	20	ns
Chip Select to Output	tCO	-	15	-	17	-	20	ns
Output Enable to Valid Output	tOE	-	7	-	8	-	9	ns
Chip Enable to Low-Z Output	tLZ	3	-	3	-	3	-	ns
Output Enable to Low-Z Output	tOLZ	0	-	0	-	0	-	ns
Chip Disable to High-Z Output	tHZ	0	7	0	8	0	9	ns
Output Disable to High-Z Output	tOHZ	0	7	0	8	0	9	ns
Output Hold from Address Change	tOH	3	-	3	-	3	-	ns
Chip Selection to Power Up Time	tPU	0	-	0	-	0	-	ns
Chip Selection to Power Down Time	tPD	-	15	-	17	-	20	ns

NOTE: The above parameters are also guaranteed at extended and industrial temperature ranges.

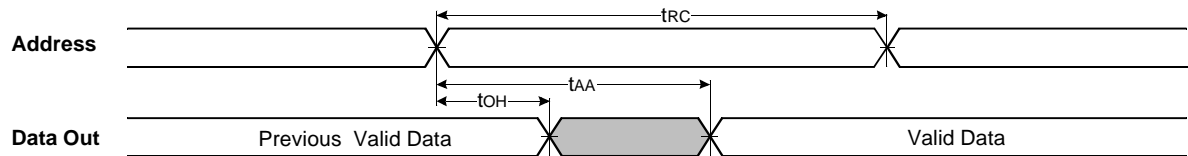
WRITE CYCLE

Parameter	Symbol	KM644002A-15		KM644002A-17		KM644002A-20		Unit
		Min	Max	Min	Max	Min	Max	
Write Cycle Time	tWC	15	-	17	-	20	-	ns
Chip Select to End of Write	tCW	12	-	13	-	14	-	ns
Address Set-up Time	tAS	0	-	0	-	0	-	ns
Address Valid to End of Write	tAW	12	-	13	-	14	-	ns
Write Pulse Width( $\overline{OE}$ High)	tWP	12	-	13	-	14	-	ns
Write Pulse Width( $\overline{OE}$ Low)	tWP1	15	-	17	-	20	-	ns
Write Recovery Time	tWR	0	-	0	-	0	-	ns
Write to Output High-Z	tWHZ	0	7	0	8	0	9	ns
Data to Write Time Overlap	tdW	8	-	9	-	10	-	ns
Data Hold from Write Time	tdH	0	-	0	-	0	-	ns
End Write to Output Low-Z	tOW	3	-	3	-	3	-	ns

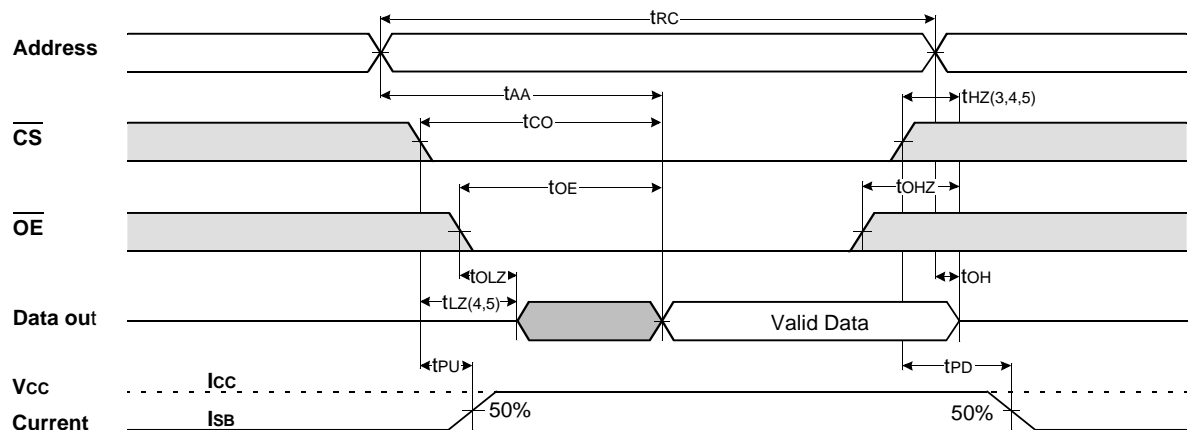
NOTE: The above parameters are also guaranteed at extended and industrial temperature ranges.

TIMING DIAGRAMS

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



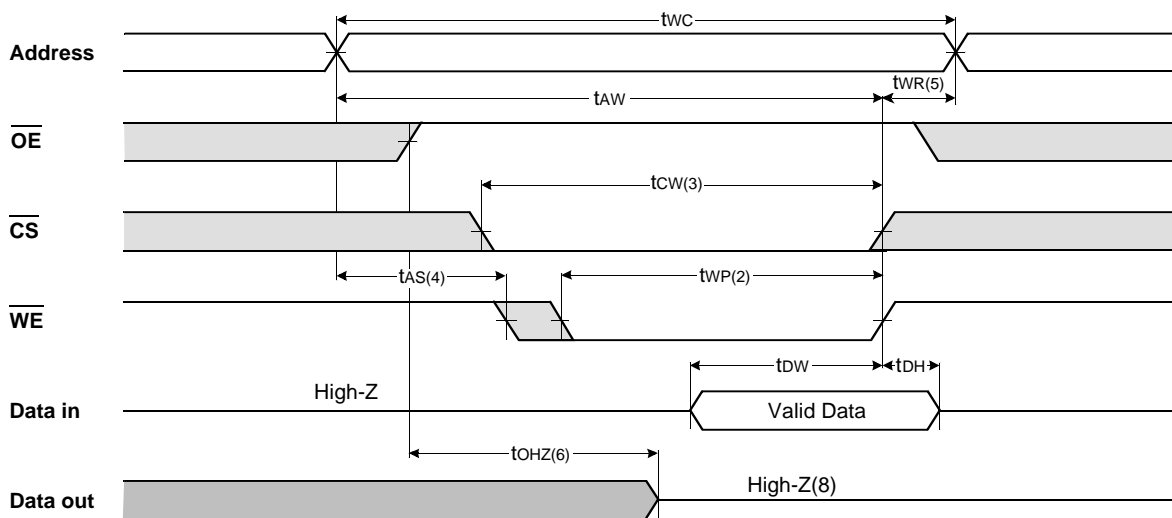
TIMING WAVEFORM OF READ CYCLE(2) ( $\overline{WE}=V_{IH}$ )



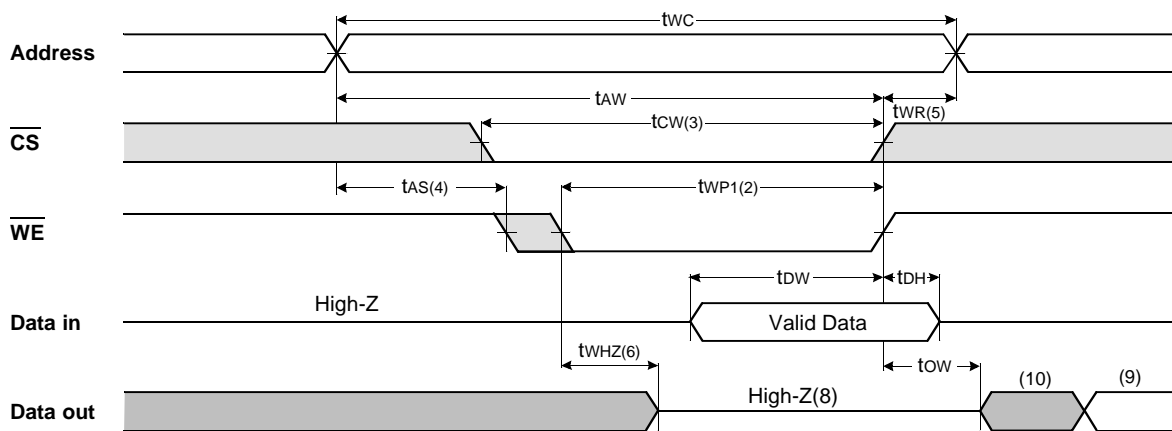
NOTES(READ CYCLE)

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  $t_{OHZ}$  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.

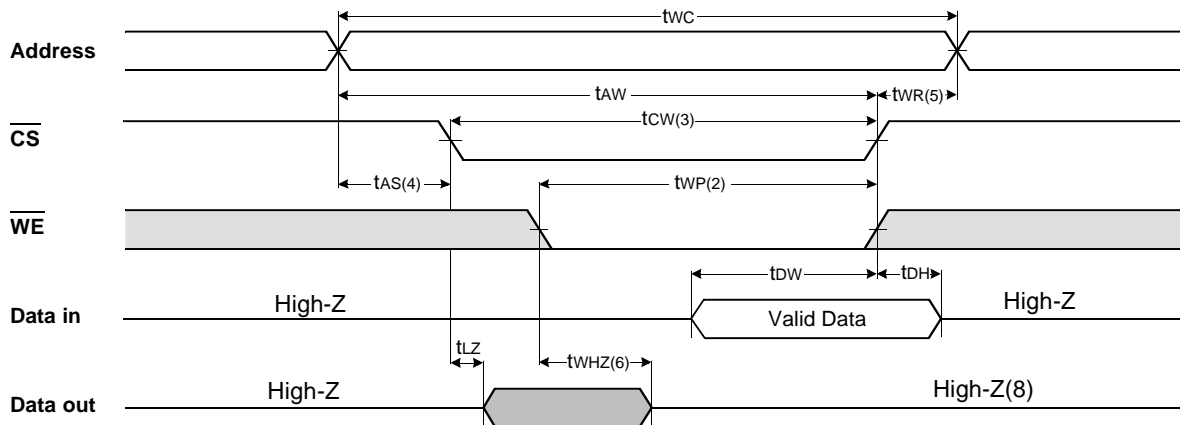
TIMING WAVEFORM OF WRITE CYCLE(1) ( $\overline{OE}$ = Clock)



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 CS and WE. A write begins at the latest transition CS going low and WE going low ; A write ends at the earliest transition CS going high or WE going high. tWP is measured from the beginning of write to the end of write.
3. tCW is measured from the later of CS going low to end of write.
4. tAS is measured from the address valid to the beginning of write.
5. tWR is measured from the end of write to the address change. tWR applied in case a write ends as CS or WE going high.
6. If OE, CS and 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 CS goes low simultaneously with WE going or after WE going low, the outputs remain high impedance state.
9. Dout is the read data of the new address.
10. When 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	ISB, ISB1
L	H	H	Output Disable	High-Z	Icc
L	H	L	Read	DOUT	Icc
L	L	X	Write	DIN	Icc

\* NOTE : X means Don't Care.

