

Document Title

64Kx16 Bit High Speed Static RAM(5V Operating), Revolutionary Pin out.  
Operated at Commercial and Industrial Temperature Ranges.

Revision History

<u>Rev. No.</u>	<u>History</u>	<u>Draft Data</u>	<u>Remark</u>
Rev. 0.0	Initial release with Preliminary.	Apr. 22th, 1995	Preliminary
Rev. 1.0	Release to final Data Sheet. 1.1. Delete Preliminary.	Feb. 29th, 1996	Final
Rev. 2.0	Update D.C parameters. 2.1. Update D.C parameters. <div> <div>Items</div> <div> <div>Previous spec. (12/15/17/20ns part)</div> <div>Updated spec. (12/15/17/20ns part)</div> </div> <div> <div>Icc</div> <div>220/210/200/190mA</div> <div>190/185/185/180mA</div> </div> <div> <div>Isb</div> <div>30mA</div> <div>25mA</div> </div> <div> <div>Isb1</div> <div>10mA</div> <div>8mA</div> </div> </div>	Jul. 16th, 1996	Final
Rev. 3.0	Add Industrial Temperature Range parts. 3.1. Add Industrial Temperature Range parts with the same parameters as Commercial Temperature Range parts. 3.1.1. Add KM6R1016C1A parts for Industrial Temperature Range. 3.1.2. Add ordering information. 3.1.3. Add the condition for operating at Industrial Temp. Range. 3.2. Add the test condition for VOH1 with Vcc=5V±5% at 25°C. 3.3. Add timing diagram to define tWP1 as "(Timing Wave Form of Write Cycle(OE=Low fixed))".	Jun. 2nd, 1997	Final
Rev. 4.0	4.1. Delete 17ns Part.	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.

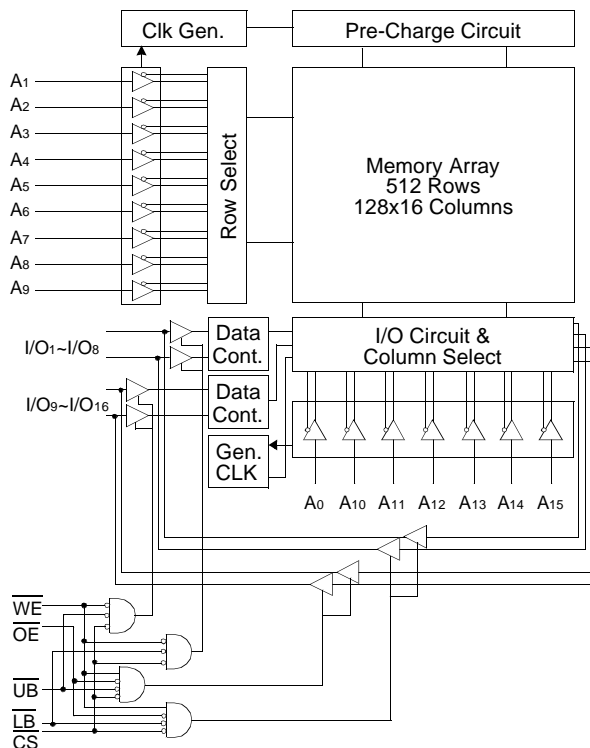


**64K x 16 Bit High-Speed CMOS Static RAM****FEATURES**

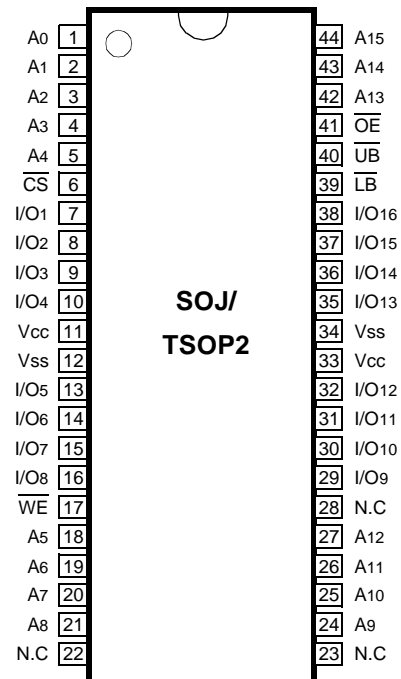
- Fast Access Time 12, 15, 20ns(Max.)
- Low Power Dissipation
  - Standby (TTL) : 25mA(Max.)
  - (CMOS) : 8mA(Max.)
  - Operating K6R1016C1A-12 : 190mA(Max.)
  - K6R1016C1A-15 : 185mA(Max.)
  - K6R1016C1A-20 : 180mA(Max.)
- Single 5.0V  $\pm 10\%$  Power Supply
- TTL Compatible Inputs and Outputs
- I/O Compatible with 3.3V Device
- Fully Static Operation
  - No Clock or Refresh required
- Three State Outputs
- Center Power/Ground Pin Configuration
- Data Byte Control : LB:I/O<sub>1</sub>~I/O<sub>8</sub>, UB:I/O<sub>9</sub>~I/O<sub>16</sub>
- Standard Pin Configuration
  - K6R1016C1A-J : 44-SOJ-400
  - K6R1016C1A-T : 44-TSOP2-400BF

**ORDERING INFORMATION**

K6R1016C1A-C12/C15/C20	Commercial Temp.
K6R1016C1A-I12/I15/I20	Industrial Temp.

**FUNCTIONAL BLOCK DIAGRAM****GENERAL DESCRIPTION**

The K6R1016C1A is a 1,048,576-bit high-speed Static Random Access Memory organized as 65,536 words by 16 bits. The K6R1016C1A uses 16 common input and output lines and has an output enable pin which operates faster than address access time at read cycle. Also it allows that lower and upper byte access by data byte control(UB, LB). 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 K6R1016C1A is packaged in a 400mil 44-pin plastic SOJ or TSOP2 forward.

**PIN CONFIGURATION (Top View)****PIN FUNCTION**

Pin Name	Pin Function
A0 - A15	Address Inputs
$\overline{WE}$	Write Enable
$\overline{CS}$	Chip Select
$\overline{OE}$	Output Enable
$\overline{LB}$	Lower-byte Control(I/O <sub>1</sub> ~I/O <sub>8</sub> )
$\overline{UB}$	Upper-byte Control(I/O <sub>9</sub> ~I/O <sub>16</sub> )
I/O <sub>1</sub> ~ I/O <sub>16</sub>	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
	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

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

\*\* 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 $\overline{CS}=V_{IL}$ , V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OUT</sub> =0mA	12ns	-	190	mA
			15ns	-	185	
			20ns	-	180	
Standby Current	I <sub>SB</sub>	Min. Cycle, $\overline{CS}=V_{IH}$		-	25	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		-	8	
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> =-0.1mA		-	3.95	V

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

\*\* V<sub>CC</sub>=5.0V±5%, 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	-	6	pF

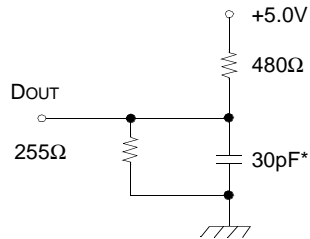
\* Capacitance is sampled and not 100% tested.

**AC CHARACTERISTICS**( $T_A=0$  to  $70^{\circ}\text{C}$ ,  $V_{CC}=5.0\text{V}\pm 10\%$ , 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

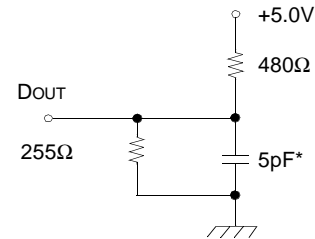
\* The above test conditions are also applied at industrial temperature range.

Output Loads(A)



Output Loads(B)

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



\* Including Scope and Jig Capacitance

**READ CYCLE\***

Parameter	Symbol	K6R1016C1A-12		K6R1016C1A-15		K6R1016C1A-20		Unit
		Min	Max	Min	Max	Min	Max	
Read Cycle Time	t <sub>RC</sub>	12	-	15	-	20	-	ns
Address Access Time	t <sub>AA</sub>	-	12	-	15	-	20	ns
Chip Select to Output	t <sub>CO</sub>	-	12	-	15	-	20	ns
Output Enable to Valid Output	t <sub>OE</sub>	-	6	-	7	-	9	ns
$\overline{\text{UB}}$ , $\overline{\text{LB}}$ Access Time	t <sub>BA</sub>	-	6	-	7	-	9	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
$\overline{\text{UB}}$ , $\overline{\text{LB}}$ Enable to Low-Z Output	t <sub>BLZ</sub>	0	-	0	-	0	-	ns
Chip Disable to High-Z Output	t <sub>HZ</sub>	0	6	0	7	0	9	ns
Output Disable to High-Z Output	t <sub>OHZ</sub>	0	6	0	7	0	9	ns
$\overline{\text{UB}}$ , $\overline{\text{LB}}$ Disable to High-Z Output	t <sub>BHZ</sub>	0	6	0	7	0	9	ns
Output Hold from Address Change	t <sub>OH</sub>	3	-	3	-	3	-	ns

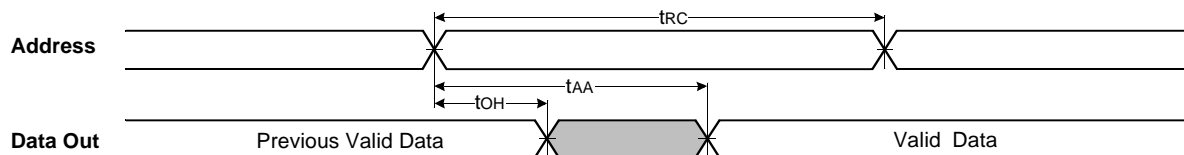
\* The above parameters are also guaranteed at industrial temperature range.

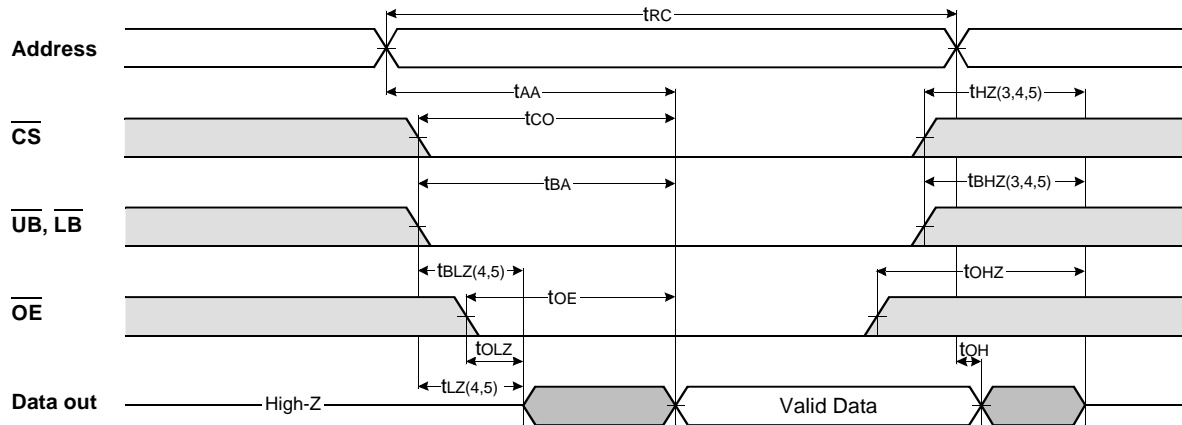
## WRITE CYCLE\*

Parameter	Symbol	K6R1016C1A-12		K6R1016C1A-15		K6R1016C1A-20		Unit
		Min	Max	Min	Max	Min	Max	
Write Cycle Time	tWC	12	-	15	-	20	-	ns
Chip Select to End of Write	tCW	8	-	10	-	12	-	ns
Address Set-up Time	tAS	0	-	0	-	0	-	ns
Address Valid to End of Write	tAW	8	-	10	-	12	-	ns
Write Pulse Width( $\overline{OE}$ High)	tWP	8	-	10	-	12	-	ns
Write Pulse Width( $\overline{OE}$ Low)	tWP1	12	-	15	-	20	-	ns
$\overline{UB}$ , $\overline{LB}$ Valid to End of Write	tBW	8	-	10	-	12	-	ns
Write Recovery Time	tWR	0	-	0	-	0	-	ns
Write to Output High-Z	tWHZ	0	6	0	7	0	9	ns
Data to Write Time Overlap	tDW	6	-	7	-	9	-	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.

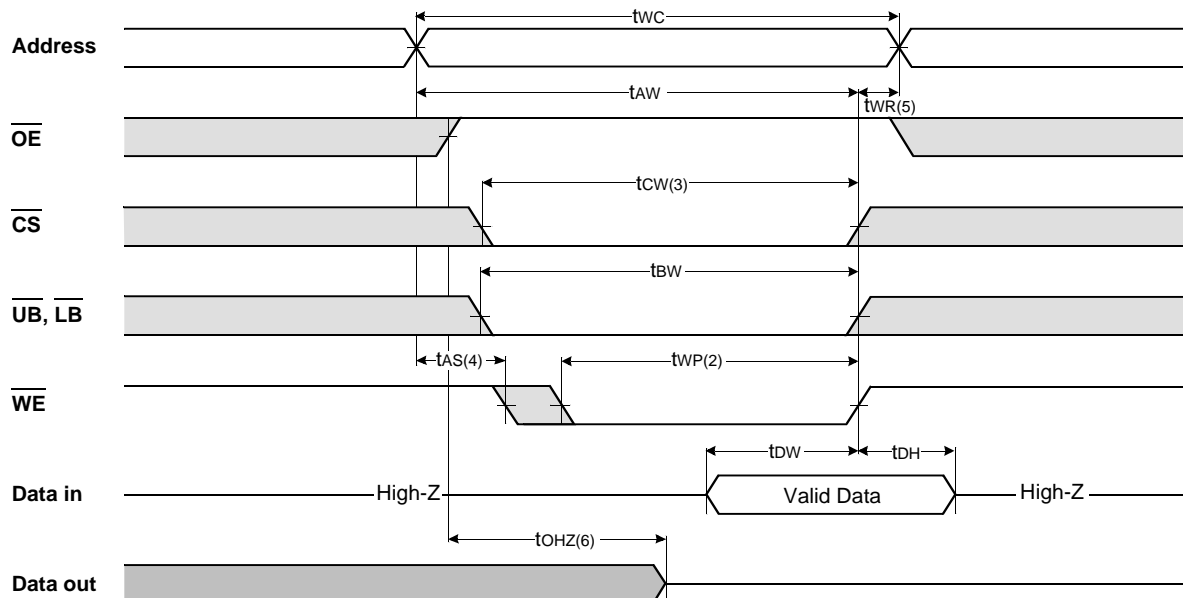
## TIMMING DIAGRAMS

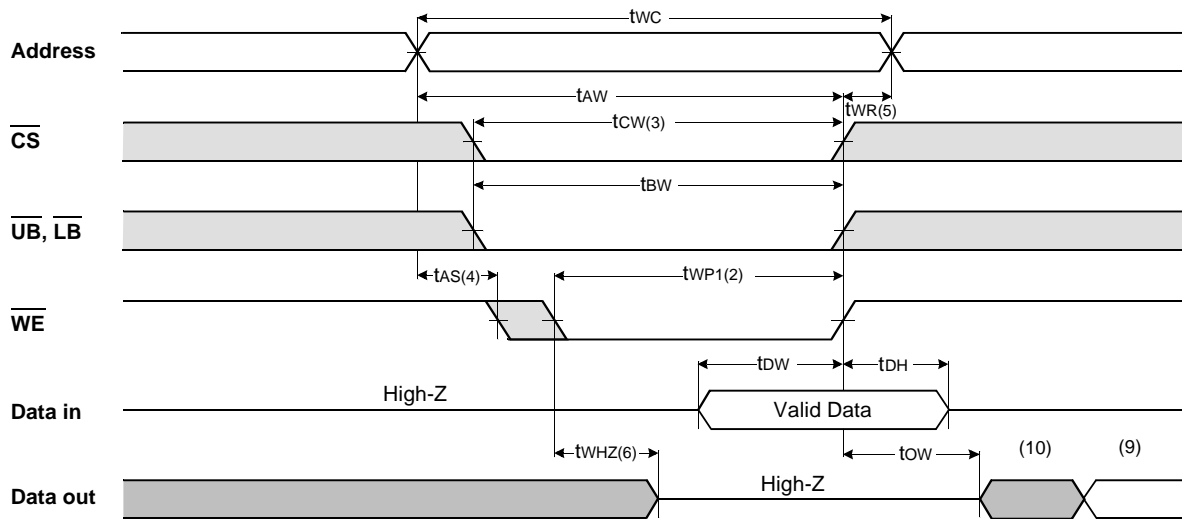
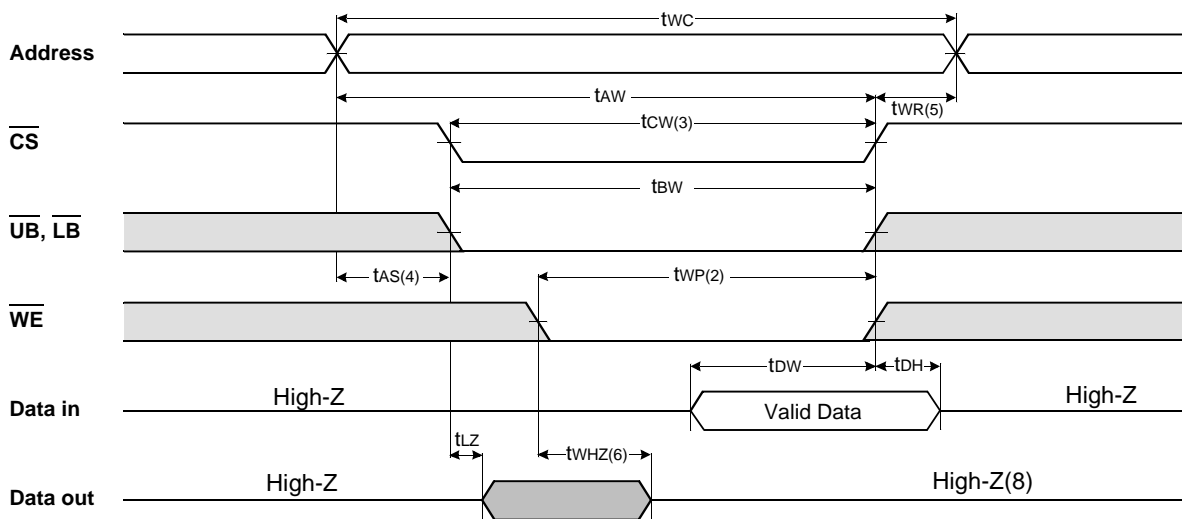
TIMING WAVEFORM OF READ CYCLE(1) (Address Controlled,  $\overline{CS}=\overline{OE}=V_{IL}$ ,  $\overline{WE}=V_{IH}$ ,  $\overline{UB}$ ,  $\overline{LB}=V_{IL}$ )

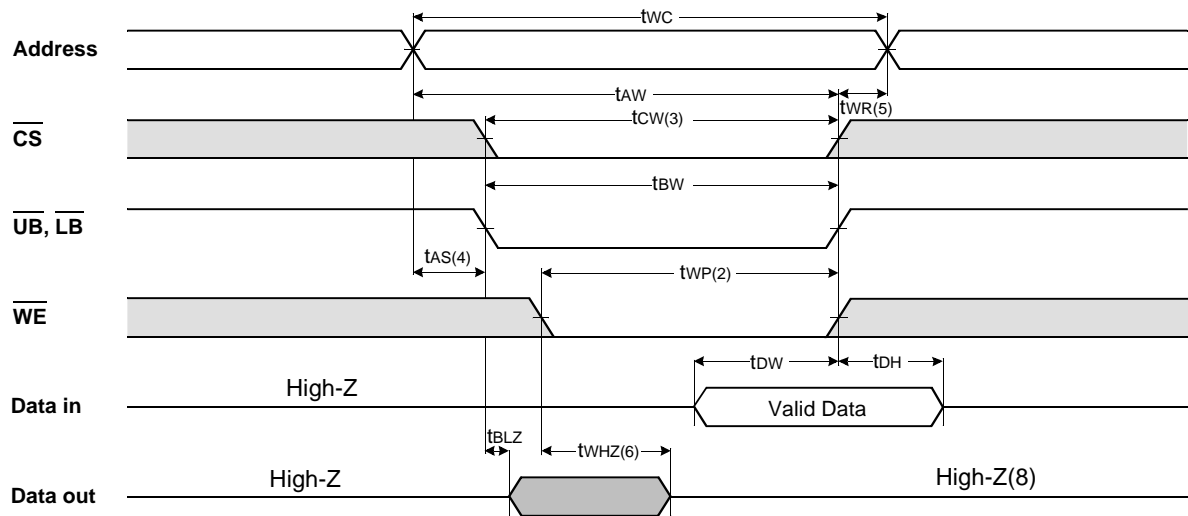
TIMING WAVEFORM OF READ CYCLE(2) ( $\overline{WE}=V_{IH}$ )

## NOTES(READCYCLE)

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)

TIMING WAVEFORM OF WRITE CYCLE(4) ( $\overline{UB}$ ,  $\overline{LB}$  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  $\overline{CS}$ ,  $\overline{WE}$ ,  $\overline{LB}$  and  $\overline{UB}$ . 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. Data 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

$\overline{CS}$	$\overline{WE}$	$\overline{OE}$	$\overline{LB}$	$\overline{UB}$	Mode	I/O Pin		Supply Current
						I/O1~I/O8	I/O9~I/O16	
H	X	X*	X	X	Not Select	High-Z	High-Z	$I_{SB}$ , $I_{SB1}$
L	H	H	X	X	Output Disable	High-Z	High-Z	$I_{CC}$
L	X	X	H	H		High-Z	High-Z	
L	H	L	L	H		DOUT	High-Z	
L	L	X	H	L	Read	High-Z	DOUT	$I_{CC}$
			L	L		DOUT	DOUT	
			L	H		DIN	High-Z	
L	L	X	H	L	Write	High-Z	DIN	$I_{CC}$
			L	L		DIN	DIN	
			L	L		DIN	DIN	

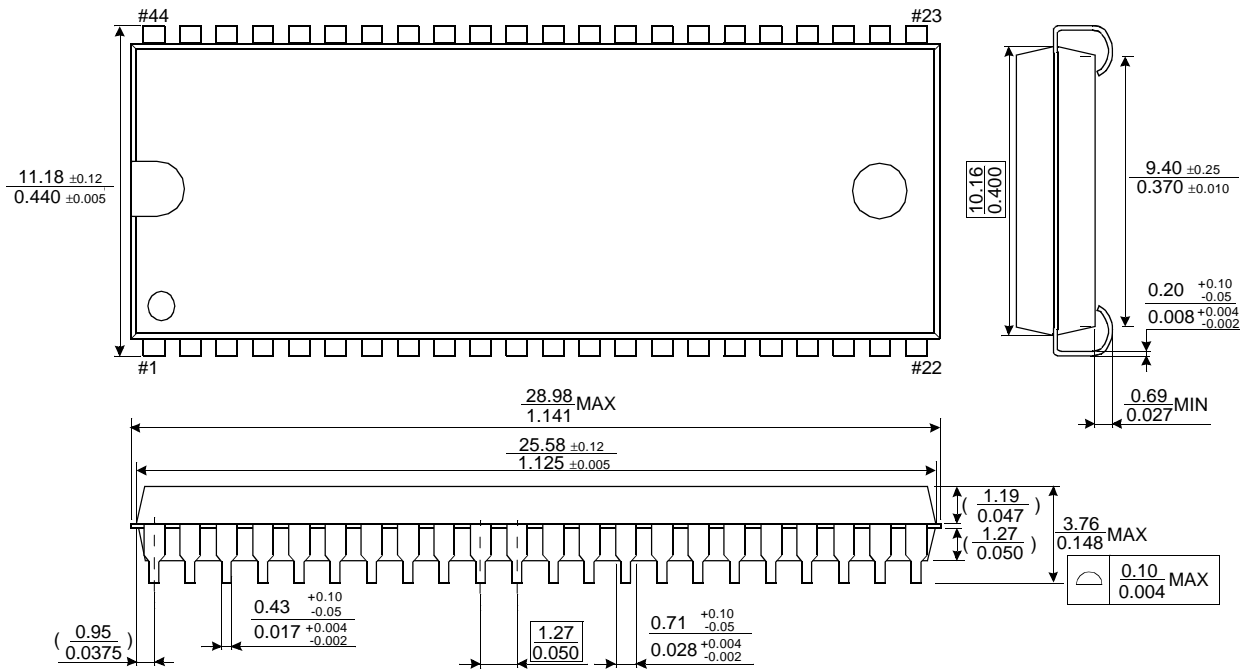
\* X means Don't Care.



## PACKAGE DIMENSIONS

Units: millimeters/Inches

## 44-SOJ-400



## 44-TSOP2-400BF

Units: millimeters/Inches

