

**Document Title**

**64Kx16 Bit High-Speed CMOS Static RAM(5.0V Operating)  
Operated at Commercial and Industrial Temperature Range.**

**Revision History**

<b><u>Rev.No.</u></b>	<b><u>History</u></b>	<b><u>Draft Data</u></b>	<b><u>Remark</u></b>										
Rev. 0.0	Initial Draft	Aug. 5. 1998	Preliminary										
Rev. 1.0	Relex DC characteristics	Sep. 7. 1998	Preliminary										
	<table border="1"> <thead> <tr> <th>Item</th> <th>Previous</th> <th>Current</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Icc</td> <td>12ns</td> <td>90mA</td> </tr> <tr> <td>15ns</td> <td>88mA</td> </tr> <tr> <td>20ns</td> <td>85mA</td> </tr> </tbody> </table>	Item	Previous	Current	Icc	12ns	90mA	15ns	88mA	20ns	85mA		
Item	Previous	Current											
Icc	12ns	90mA											
	15ns	88mA											
	20ns	85mA											
Rev. 2.0	Add 48-fine pitch BGA	Sep. 17. 1998	Preliminary										
Rev. 2.1	Changed device part name for FP-BGA	Nov. 5. 1998	Final										
	<table border="1"> <thead> <tr> <th>Item</th> <th>Previous</th> <th>Changed</th> </tr> </thead> <tbody> <tr> <td>Symbol</td> <td>Z</td> <td>F</td> </tr> </tbody> </table>	Item	Previous	Changed	Symbol	Z	F						
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ex) KM6161002CZ → KM6161002CF

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

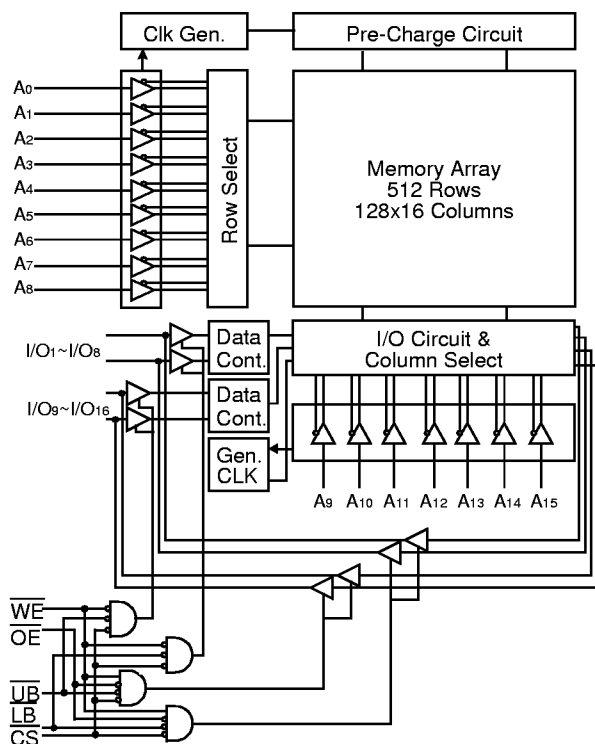
- Fast Access Time 12,15,20ns(Max.)
- Low Power Dissipation
  - Standby (TTL) : 30mA(Max.)
  - (CMOS) : 5mA(Max.)
  - 0.5mA(Max.) L-ver. only
- Operating KM6161002C/CL - 12 : 95mA(Max.)
- KM6161002C/CL - 15 : 93mA(Max.)
- KM6161002C/CL - 20 : 90mA(Max.)
- Single 5.0V±10% Power Supply
- TTL Compatible 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
- Data Byte Control : LB : I/O1~ I/O8, UB : I/O9~ I/O16
- Standard Pin Configuration :
  - KM6161002CJ : 44-SOJ-400
  - KM6161002CT : 44-TSOP2-400F
  - \*KM6161002CF : 48-Fine pitch BGA with 0.75 Ball pitch

GENERAL DESCRIPTION

The KM6161002C is a 1,048,576-bit high-speed Static Random Access Memory organized as 65,536 words by 16 bits. The KM6161002C 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 ( $\overline{UB}$ ,  $\overline{LB}$ ). 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 KM6161002C is packaged in a 400mil 44-pin plastic SOJ or TSOP2 forward or 48-Fine pitch BGA.

\*Preliminary

FUNCTIONAL BLOCK DIAGRAM



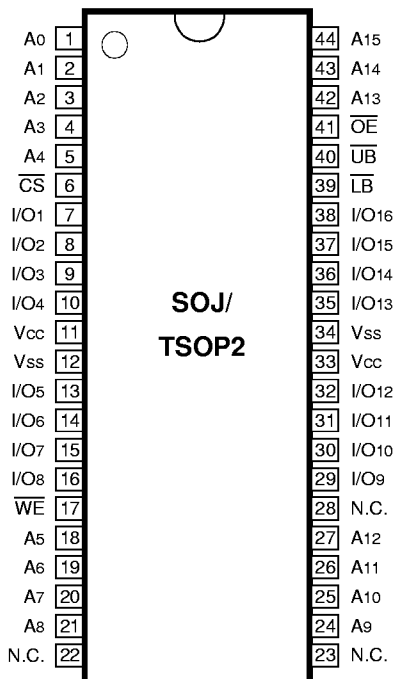
ORDERING INFORMATION

KM6161002C/CL -12/15/20	Commercial Temp.
KM6161002CI/CLI -12/15/20	Industrial Temp.

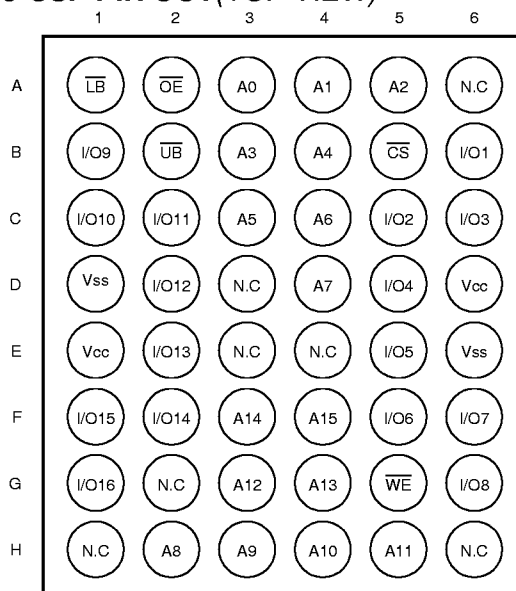
PIN FUNCTION

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/O1~I/O8)
$\overline{UB}$	Upper-byte Control(I/O9~I/O16)
I/O1 ~ I/O16	Data Inputs/Outputs
Vcc	Power(+5.0V)
Vss	Ground
N.C	No Connection

PIN CONFIGURATION(TOP VIEW)



48-CSP PIN OUT(TOP VIEW)



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 V <sub>CC</sub> +0.5	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	W
Storage Temperature	T <sub>STG</sub>	-65 to 150	°C
Operating Temperature	Commercial	T <sub>A</sub>	0 to 70
	Industrial	T <sub>A</sub>	-40 to 85

\* 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>= 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 industrial temperature range.

\* 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**( $T_A=0$  to  $70^\circ\text{C}$ ,  $V_{CC}=5.0\text{V}\pm 10\%$ , unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Max	Unit	
Input Leakage Current	$I_{LI}$	$V_{IN}=V_{SS}$ to $V_{CC}$	-2	2	$\mu\text{A}$	
Output Leakage Current	$I_{LO}$	$\overline{CS}=V_{IH}$ or $\overline{OE}=V_{IH}$ or $\overline{WE}=V_{IL}$ $V_{OUT}=V_{SS}$ to $V_{CC}$	-2	2	$\mu\text{A}$	
Operating Current	$I_{CC}$	Min. Cycle, 100% Duty $\overline{CS}=V_{IL}$ , $V_{IN} = V_{IH}$ or $V_{IL}$ , $I_{OUT}=0\text{mA}$	12ns	-	95	mA
			15ns	-	93	
			20ns	-	90	
Standby Current	$I_{SB}$	Min. Cycle, $\overline{CS}=V_{IH}$	-	30	mA	
	$I_{SB1}$	$f=0\text{MHz}$ , $\overline{CS} \geq V_{CC}-0.2\text{V}$ , $V_{IN} \geq V_{CC}-0.2\text{V}$ or $V_{IN} \leq 0.2\text{V}$	Normal	5		mA
			L-Ver.	0.5		
Output Low Voltage Level	$V_{OL}$	$I_{OL}=-8\text{mA}$	-	0.4	V	
Output High Voltage Level	$V_{OH}$	$I_{OH}=-4\text{mA}$	2.4	-	V	
	$V_{OH1}^*$	$I_{OH1}=-0.1\text{mA}$	-	3.95		

NOTE: The above parameters are also guaranteed at industrial temperature range.  
\*  $V_{CC}=5.0\text{V}$ ,  $\text{Temp.}=25^\circ\text{C}$

**CAPACITANCE\***( $T_A=25^\circ\text{C}$ ,  $f=1.0\text{MHz}$ )

Item	Symbol	Test Conditions	MIN	Max	Unit
Input/Output Capacitance	$C_{I/O}$	$V_{I/O}=0\text{V}$	-	8	pF
Input Capacitance	$C_{IN}$	$V_{IN}=0\text{V}$	-	6	pF

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

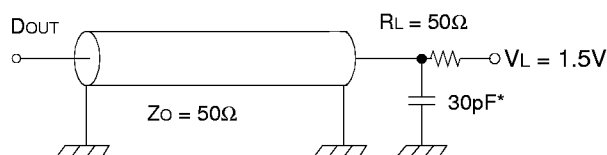
**AC CHARACTERISTICS**( $T_A=0$  to  $70^\circ\text{C}$ ,  $V_{CC}=5.0\text{V}\pm 10\%$ , unless otherwise noted.)

**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

NOTE: The above test conditions are also applied at industrial temperature range.

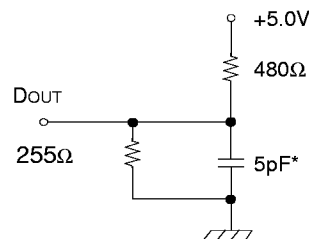
Output Loads(A)



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

Output Loads(B)

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



\* Including Scope and Jig Capacitance

READ CYCLE

Parameter	Symbol	KM6161002C/CL-12		KM6161002C/CL-15		KM6161002C/CL-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
$\overline{UB}$ , $\overline{LB}$ Access Time	t <sub>BA</sub>	-	6	-	7	-	9	ns
Chip Enable to Low-Z Output	t <sub>LZ</sub>	3	-	3	-	3	-	ns
$\overline{UB}$ , $\overline{LB}$ Enable to Low-Z Output	t <sub>BLZ</sub>	0	-	0	-	0	-	
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	6	-	7	-	9	ns
Output Disable to High-Z Output	t <sub>OHZ</sub>	0	6	-	7	-	9	ns
$\overline{UB}$ , $\overline{LB}$ Disable to High-Z Output	t <sub>BHZ</sub>	0	6	-	7	-	9	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 DownTime	t <sub>PD</sub>	-	12	-	15	-	20	ns

NOTE: The above parameters are also guaranteed at industrial temperature range.

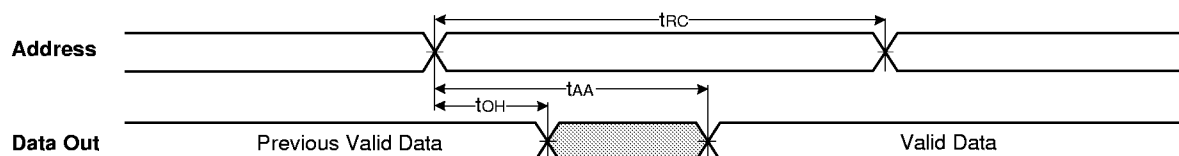
WRITE CYCLE

Parameter	Symbol	KM6161002C/CL-12		KM6161002C/CL-15		KM6161002C/CL-20		Unit
		Min	Max	Min	Max	Min	Max	
Write Cycle Time	t <sub>WC</sub>	12	-	15	-	20	-	ns
Chip Select to End of Write	t <sub>CW</sub>	8	-	9	-	10	-	ns
Address Set-up Time	t <sub>AS</sub>	0	-	0	-	0	-	ns
Address Valid to End of Write	t <sub>AW</sub>	8	-	9	-	10	-	ns
Write Pulse Width( $\overline{OE}$ High)	t <sub>WP</sub>	8	-	9	-	10	-	ns
Write Pulse Width( $\overline{OE}$ Low)	t <sub>WP1</sub>	12	-	15	-	20	-	ns
$\overline{UB}$ , $\overline{LB}$ Valid to End of Write	t <sub>BW</sub>	8	-	9	-	10	-	ns
Write Recovery Time	t <sub>WR</sub>	0	-	0	-	0	-	ns
Write to Output High-Z	t <sub>WHZ</sub>	0	6	0	7	0	9	ns
Data to Write Time Overlap	t <sub>DW</sub>	6	-	7	-	8	-	ns
Data Hold from Write Time	t <sub>DH</sub>	0	-	0	-	0	-	ns
End Write to Output Low-Z	t <sub>OW</sub>	3	-	3	-	3	-	ns

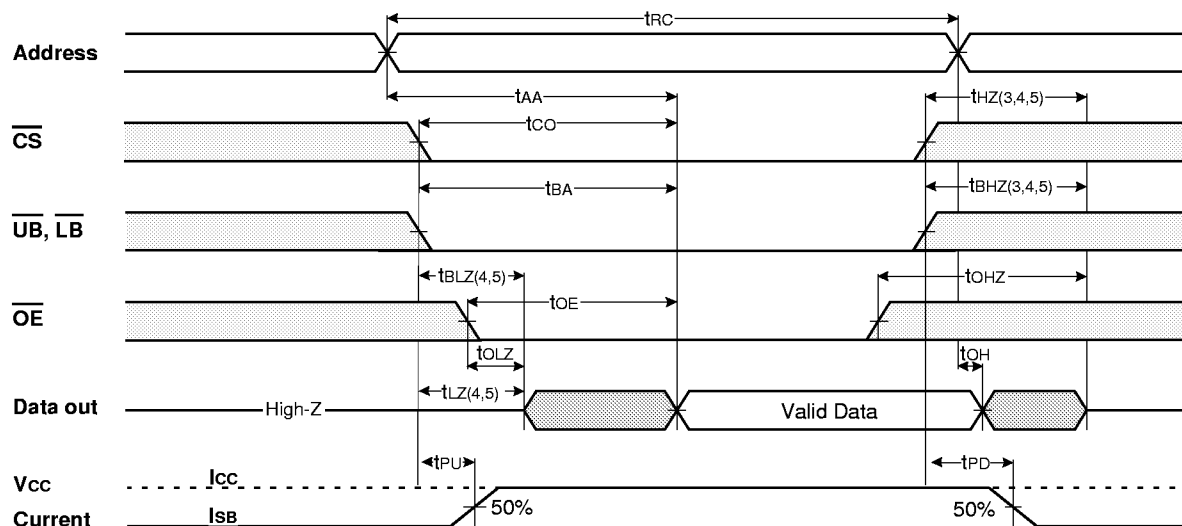
NOTE: The above parameters are also guaranteed at industrial temperature range.

TIMMING DIAGRAMS

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



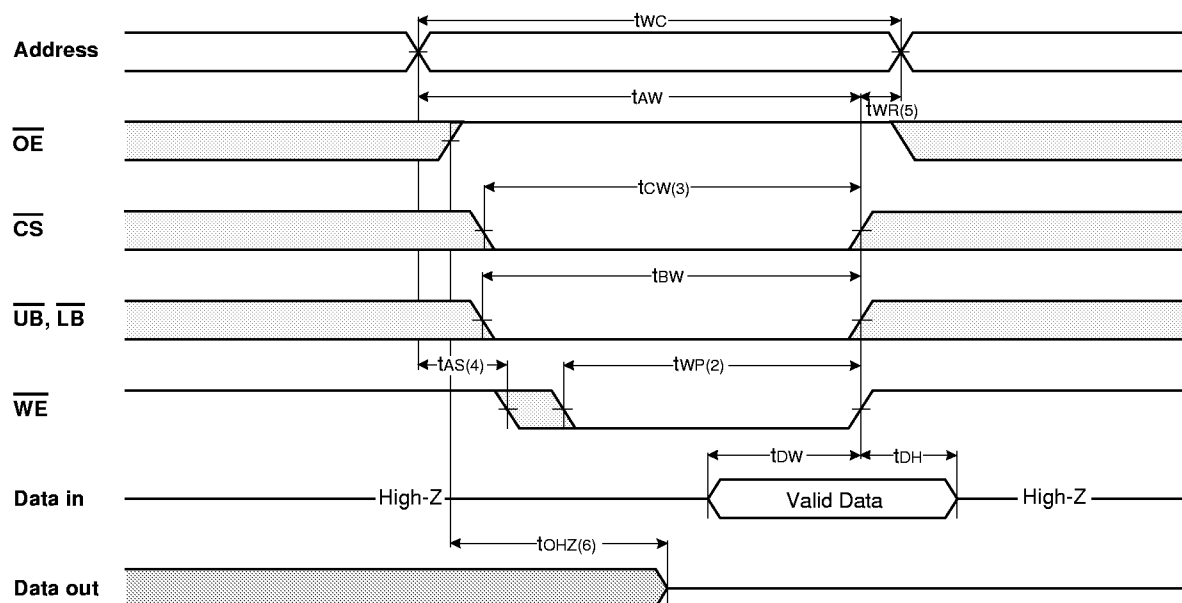
TIMING WAVEFORM OF READ CYCLE(2) ( $\overline{WE}=V_{IH}$ )



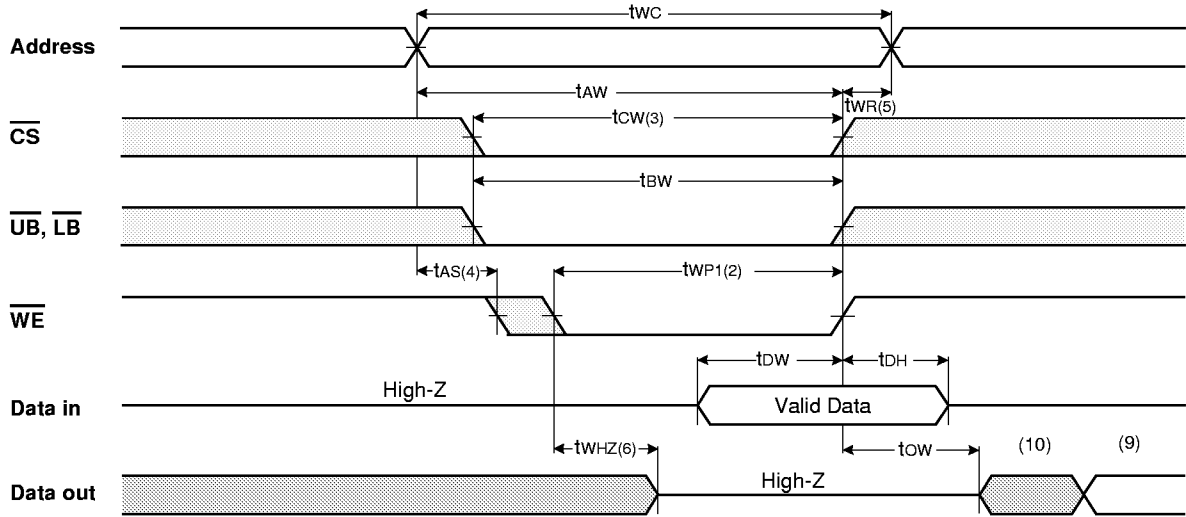
NOTES(READ CYCLE)

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.

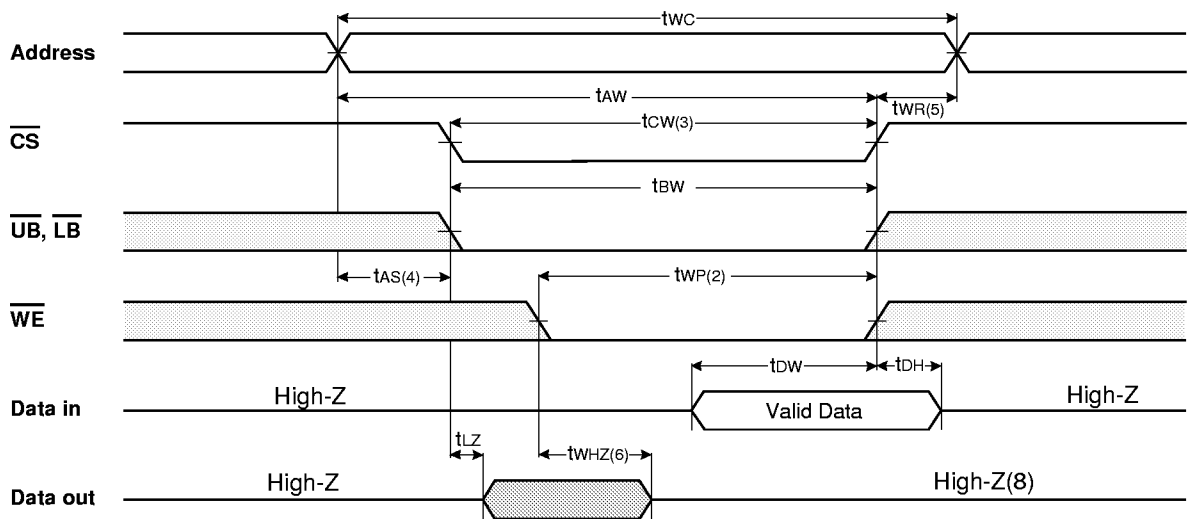
TIMING WAVEFORM OF WRITE CYCLE(1) ( $\overline{OE}=\text{Clock}$ )



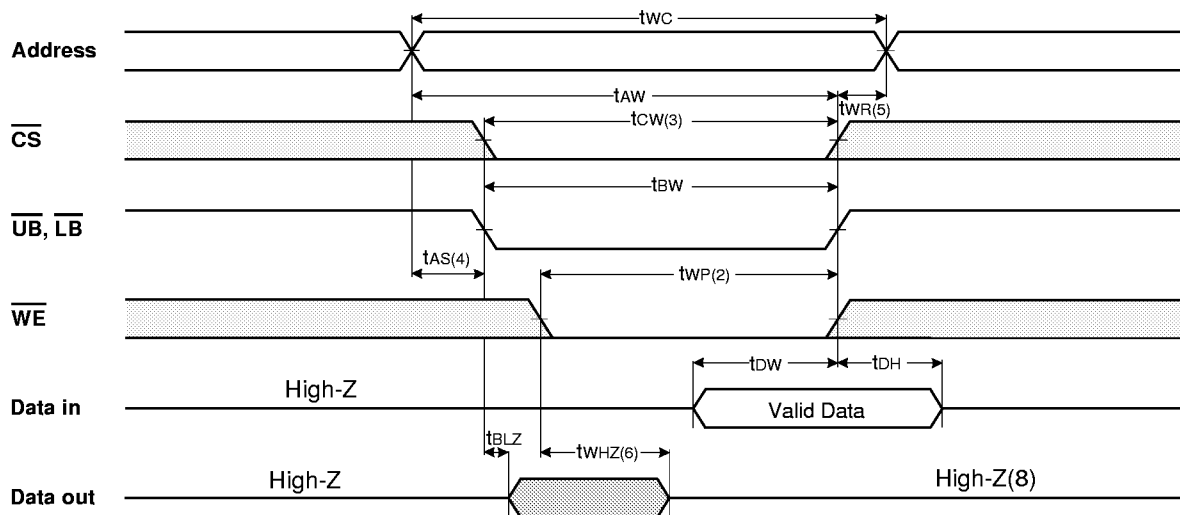
TIMING WAVEFORM OF WRITE CYCLE(2) ( $\overline{OE}$  =Low fixed)



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.  $t_{WC}$  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

$\overline{CS}$	$\overline{WE}$	$\overline{OE}$	$\overline{LB}$	$\overline{UB}$	Mode	I/O Pin		Supply Current
						I/O <sub>1</sub> ~I/O <sub>8</sub>	I/O <sub>9</sub> ~I/O <sub>16</sub>	
H	X	X*	X	X	Not Select	High-Z	High-Z	I <sub>SB</sub> , I <sub>SB1</sub>
L	H	H	X	X	Output Disable	High-Z	High-Z	I <sub>CC</sub>
L	X	X	H	H	Read	DOUT	High-Z	I <sub>CC</sub>
			L	L		High-Z	DOUT	
			L	L		DOUT	DOUT	
L	L	X	L	H	Write	DIN	High-Z	I <sub>CC</sub>
			H	L		High-Z	DIN	
			L	L		DIN	DIN	

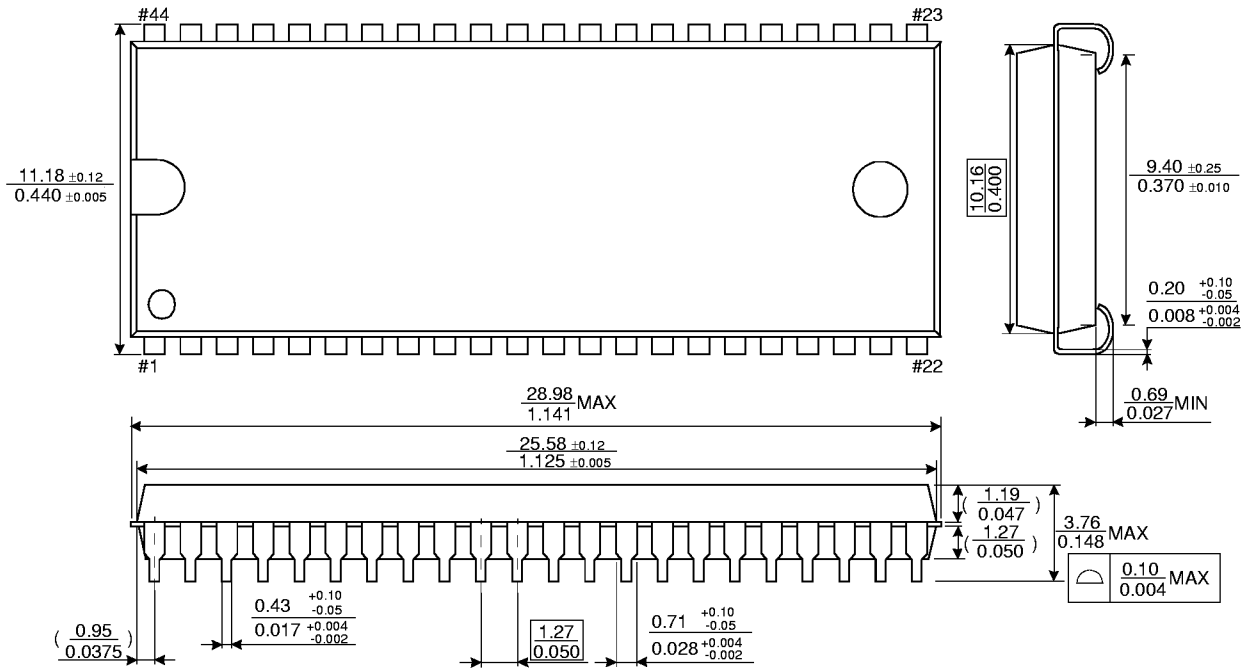
\* NOTE : X means Don't Care.



PACKAGE DIMENSIONS

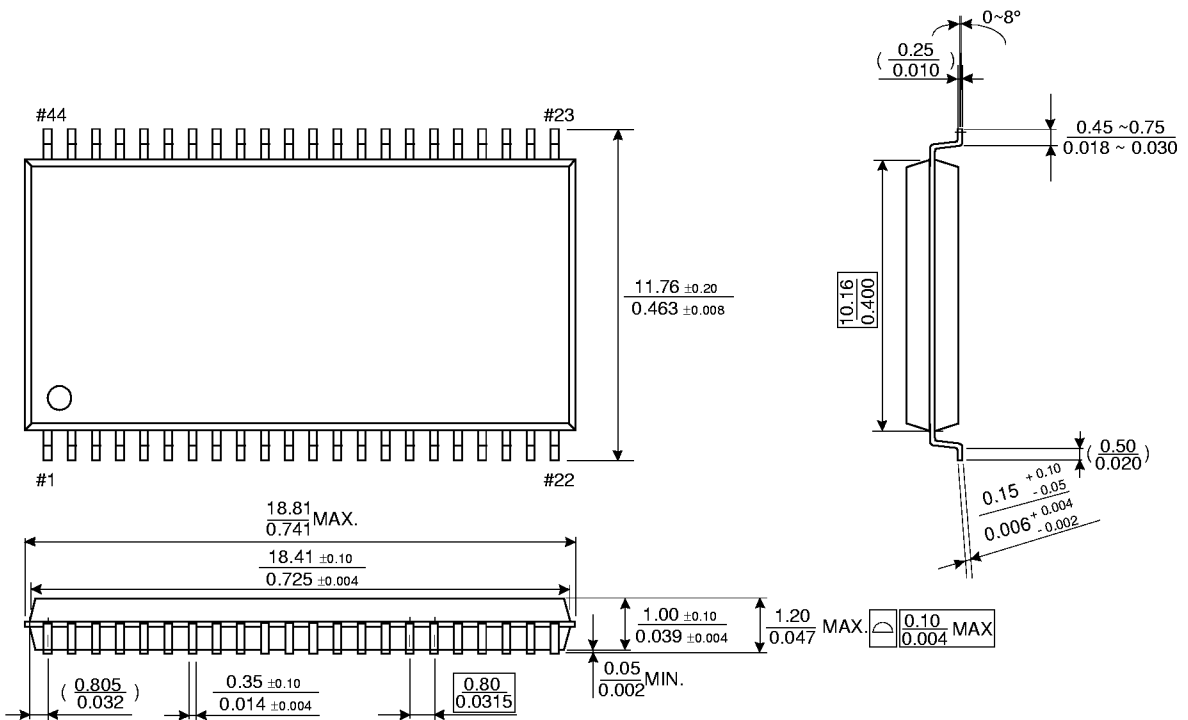
44-SOJ-400

Units: millimeters/Inches



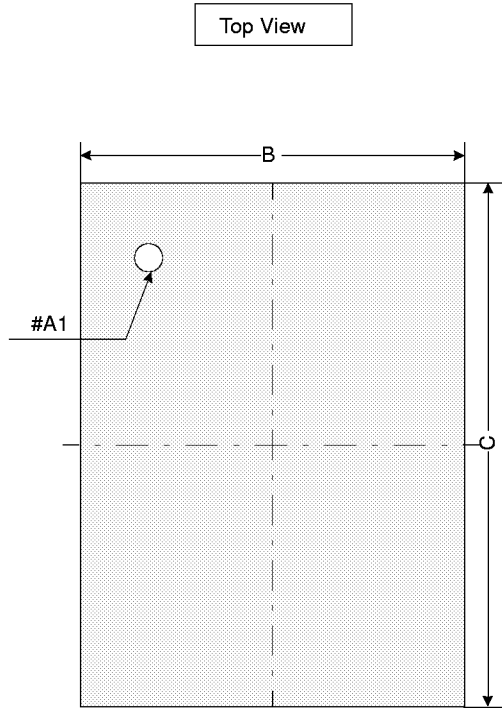
44-TSOP2-400F

Units: millimeters/Inches

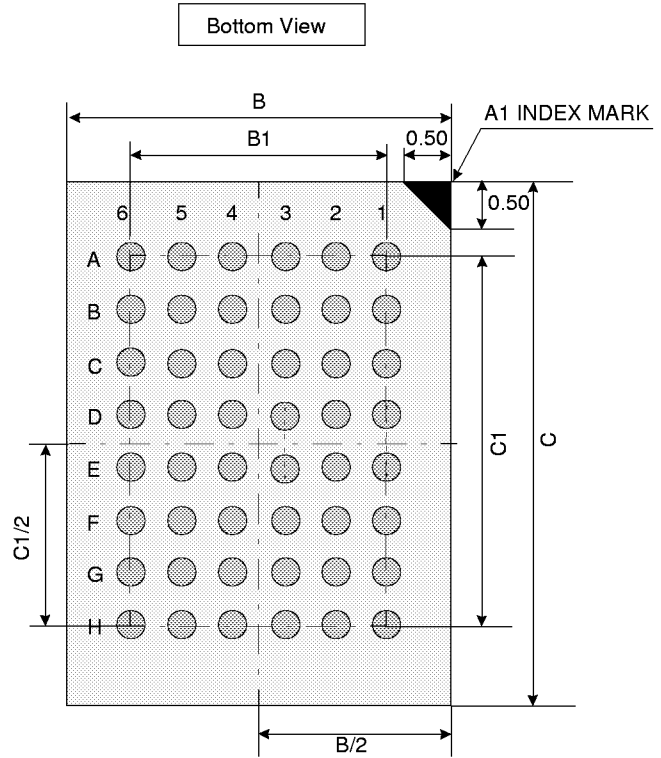


PACKAGE OUTLINE

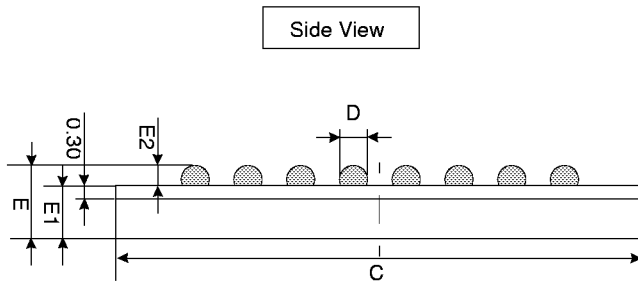
(Units : millimeter)



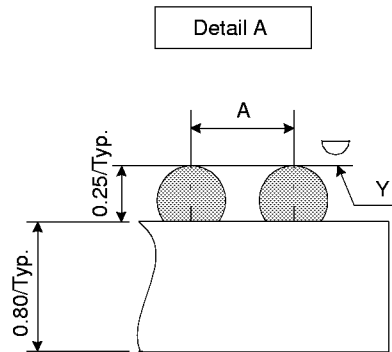
Top View



Bottom View



Side View



Detail A

	Min	Typ	Max
A	-	0.75	-
B	5.90	6.00	6.10
B1	-	3.75	-
C	6.90	7.00	7.10
C1	-	5.25	-
D	0.30	0.35	0.40
E	-	1.05	1.20
E1	-	0.80	-
E2	0.20	0.25	0.30
Y	-	-	0.08

Notes.

1. Bump counts: 48(8row x 6column)
2. Bump pitch : (x,y)=(0.75 x 0.75)(typ.)
3. All tolerance are +/-0.050 unless otherwise specified.
4. Typ : Typical
5. Y is coplanarity: 0.08(Max)