Document Title

1M x8 bit Super Low Power and Low Voltage Full CMOS Static RAM

Revision History

Revision No.	History	Draft Date	Remark
0.0	Initial draft	August 25, 1999	Preliminary
1.0	Finalize - Adopt new code. - Improve V_{IN}, V_{OUT} max. on 'ABSOLUTE MAXIMUM RATINGS' from 3.6V to V_{CC}+0.5V. - Improve V_{OH} on DC AND OPERATING CHARACTERISTICS' from 2.2 to 2.4V.	February 24, 2000	Finalize
2.0	Revise - Errata correction - Improve V_{IL} max. on RECOMMENDED DC OPERATING CONDI TIONS' from 0.4V to 0.6V. - Change t_{DW} : from 20ns to 25ns for 55ns product. from 25ns to 30ns for 70ns product. - Change t_{WHZ} : from 25ns to 20ns for 70ns product.	April 26, 2000	Final
2.01	Revise - Errata Correction : Changed 256 x8 columns to 512 x8 columns in the Functional Block Diagram.	January 7, 2002	Final

1M x 8 bit Super Low Power and Low Voltage Full CMOS Static RAM

FEATURES

- Process Technology: Full CMOS
- Organization: 1M x8
- Power Supply Voltage: 2.7~3.3V
- Low Data Retention Voltage: 1.5V(Min)
- Three state output and TTL Compatible
- Package Type: 44-TSOP2-400F/R, 48-FBGA-8.00x12.00

GENERAL DESCRIPTION

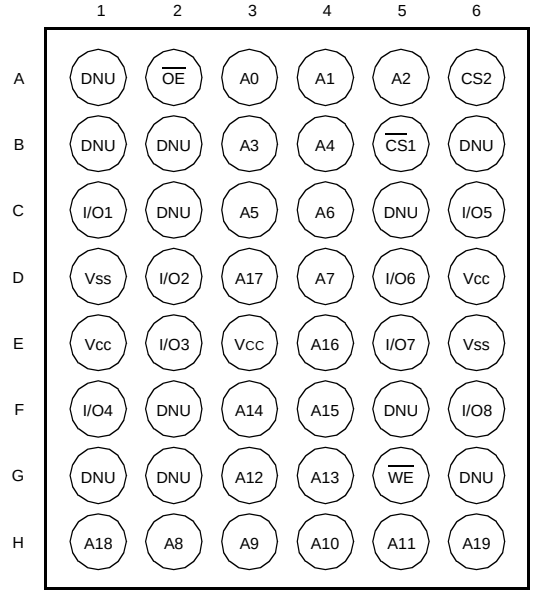
The K6F8008U2M families are fabricated by SAMSUNG′s advanced full CMOS process technology. The families support industrial operating temperature ranges and have chip scale package for user flexibility of system design. The families also support low data retention voltage for battery back-up operation with low data retention current.

PRODUCT FAMILY

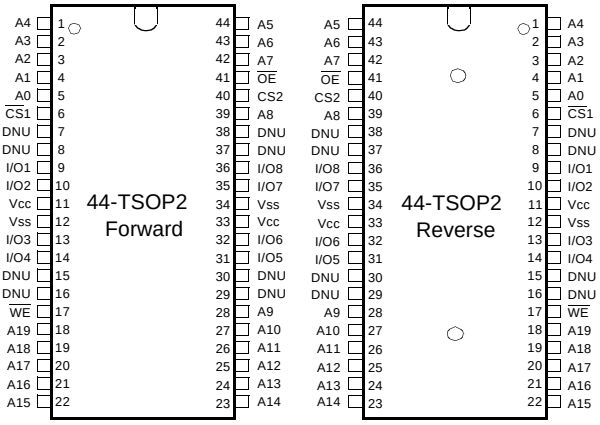
Product Family	Operating Temperature	Vcc Range	Speed	Power Dissipation		PKG Type
				Standby (I_{SB1}, Typ.)	Operating (I_{CC1}, Max)	
K6F8008U2M-F	Industrial(-40~85°C)	2.7~3.3V	55[1]/70ns	0.5µA	3mA	44-TSOP2-400F/R 48-FBGA-8.00x12.00

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

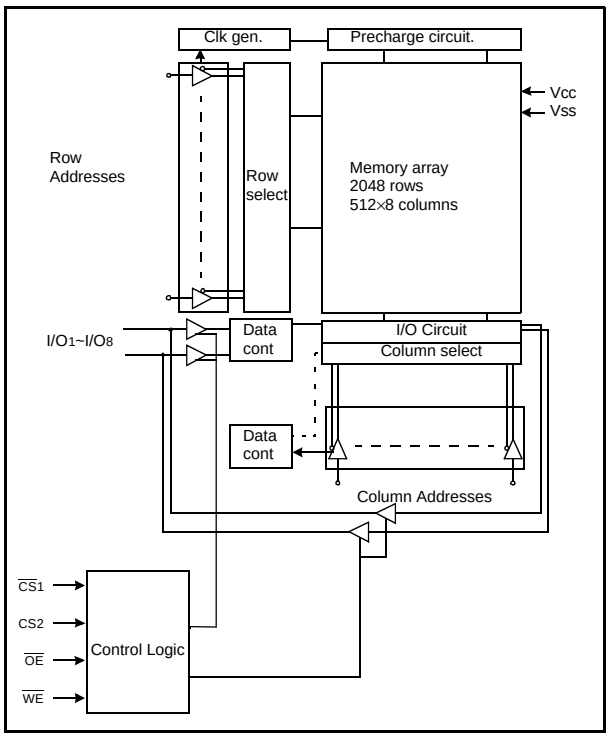
PIN DESCRIPTION



48-FBGA: Top View (Ball Down)



FUNCTIONAL BLOCK DIAGRAM



Name	Function	Name	Function
$\overline{CS}_1$, CS_2	Chip Select Inputs	A_0~A_{19}	Address Inputs
$\overline{OE}$	Output Enable Input	Vcc	Power
$\overline{WE}$	Write Enable Input	Vss	Ground
I/O_1~I/O_8	Data Inputs/Outputs	DNU	Do Not Use

PRODUCT LIST

Industrial Temperature Products(-40~85°C)	
Part Name	**Function**
K6F8008U2M-TF55	44-TSOP2-F, 55ns, 3.0V
K6F8008U2M-TF70	44-TSOP2-F, 70ns, 3.0V
K6F8008U2M-RF55	44-TSOP2-R, 55ns, 3.0V
K6F8008U2M-RF70	44-TSOP2-R, 70ns, 3.0V
K6F8008U2M-FF55	48-FBGA, 55ns, 3.0V
K6F8008U2M-FF70	48-FBGA, 70ns, 3.0V

FUNCTIONAL DESCRIPTION

$\overline{CS_1}$	CS_2	$\overline{OE}$	$\overline{WE}$	$I/O_{1\sim8}$	Mode	Power
H	X[1]	X[1]	X[1]	High-Z	Deselected	Standby
X[1]	L	X[1]	X[1]	High-Z	Deselected	Standby
L	H	H	H	High-Z	Output Disabled	Active
L	H	L	H	Dout	Read	Active
L	H	X[1]	L	Din	Write	Active

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

ABSOLUTE MAXIMUM RATINGS[1]

Item	Symbol	Ratings	Unit
Voltage on any pin relative to Vss	V_{IN}, V_{OUT}	-0.2 to V_{CC}+0.5V	V
Voltage on Vcc supply relative to Vss	V_{CC}	-0.2 to 4.0	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 CONDITIONS[1)]

Item	Symbol	Min	Typ	Max	Unit
Supply voltage	Vcc	2.7	3.0	3.3	V
Ground	Vss	0	0	0	V
Input high voltage	V_{IH}	2.2	-	Vcc+0.2[2)]	V
Input low voltage	V_{IL}	-0.2[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 ≤20ns.
3. Undershoot: -2.0V in case of pulse width ≤20ns.
4. Overshoot and undershoot are sampled, not 100% tested.

CAPACITANCE[1)] (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

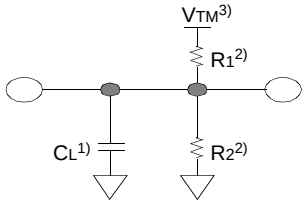
Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Input leakage current	I_{LI}	V_{IN}=Vss to Vcc	-1	-	1	µA
Output leakage current	I_{LO}	$\overline{CS_1}$=V_{IH}, CS_2=V_{IL} or $\overline{OE}$=V_{IH} or $\overline{WE}$=V_{IL}, V_{IO}=Vss to Vcc	-1	-	1	µA
Operating power supply current	I_{CC}	I_{IO}=0mA, $\overline{CS_1}$=V_{IL}, CS_2=V_{IH}, $\overline{WE}$=V_{IH}, V_{IN}=V_{IH} or V_{IL}	-	-	2	mA
Average operating current	I_{CC1}	Cycle time=1µs, 100%duty, I_{IO}=0mA, $\overline{CS_1}$≤0.2V, CS_2≥Vcc-0.2V, V_{IN}≤0.2V or V_{IN}≥VCC-0.2V	-	-	3	mA
	I_{CC2}	Cycle time=Min, I_{IO}=0mA, 100% duty, $\overline{CS_1}$=V_{IL}, CS_2=V_{IH}, VIN=V_{IL} or V_{IH}	-	-	35	mA
Output low voltage	V_{OL}	I_{OL} = 2.1mA	-	-	0.4	V
Output high voltage	V_{OH}	I_{OH} = -1.0mA	2.4	-	-	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}	$\overline{CS_1}$≥Vcc-0.2V, CS_2≥Vcc-0.2V($\overline{CS_1}$ controlled) or CS_2≤0.2V(CS_2 controlled), Other inputs=0~Vcc	-	0.5	25[1)]	µA

1. Super low power product=10µA with special handling.

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=100pF+1TTL
C_L=30pF+1TTL



1. Including scope and jig capacitance
2. R_1=3070Ω, R_2=3150Ω
3. V_{TM} =2.8V

AC CHARACTERISTICS (Vcc=2.7~3.3V, Industrial product: T_A=-40 to 85°C)

Parameter List		Symbol	Speed Bins				Units
			55ns		70ns		
			Min	Max	Min	Max	
Read	Read Cycle Time	t_{RC}	55	-	70	-	ns
	Address Access Time	t_{AA}	-	55	-	70	ns
	Chip Select to Output	t_{CO}	-	55	-	70	ns
	Output Enable to Valid Output	t_{OE}	-	25	-	35	ns
	Chip Select to Low-Z Output	t_{LZ}	10	-	10	-	ns
	Output Enable to Low-Z Output	t_{OLZ}	5	-	5	-	ns
	Chip Disable to High-Z Output	t_{HZ}	0	20	0	25	ns
	Output Disable to High-Z Output	t_{OHZ}	0	20	0	25	ns
	Output Hold from Address Change	t_{OH}	10	-	10	-	ns
Write	Write Cycle Time	t_{WC}	55	-	70	-	ns
	Chip Select to End of Write	t_{CW}	45	-	60	-	ns
	Address Set-up Time	t_{AS}	0	-	0	-	ns
	Address Valid to End of Write	t_{AW}	45	-	60	-	ns
	Write Pulse Width	t_{WP}	40	-	50	-	ns
	Write Recovery Time	t_{WR}	0	-	0	-	ns
	Write to Output High-Z	t_{WHZ}	0	20	0	20	ns
	Data to Write Time Overlap	t_{DW}	25	-	30	-	ns
	Data Hold from Write Time	t_{DH}	0	-	0	-	ns
	End Write to Output Low-Z	t_{OW}	5	-	5	-	ns

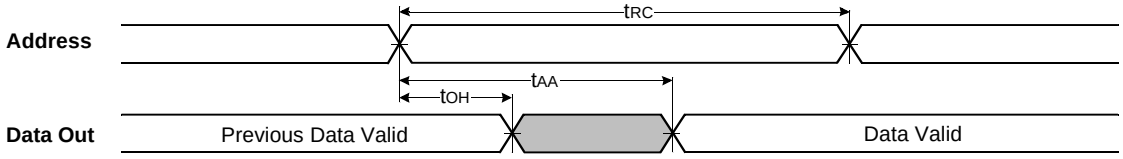
DATA RETENTION CHARACTERISTICS

Item	Symbol	Test Condition	Min	Typ	Max	Unit
Vcc for data retention	V_{DR}	$\overline{CS_1}$≥Vcc-0.2V1)	1.5	-	3.3	V
Data retention current	I_{DR}	Vcc=1.5V, $\overline{CS_1}$≥Vcc-0.2V1)	-	0.5	62)	μA
Data retention set-up time	t_{SDR}	See data retention waveform	0	-	-	ns
Recovery time	t_{RDR}		tRC	-	-	

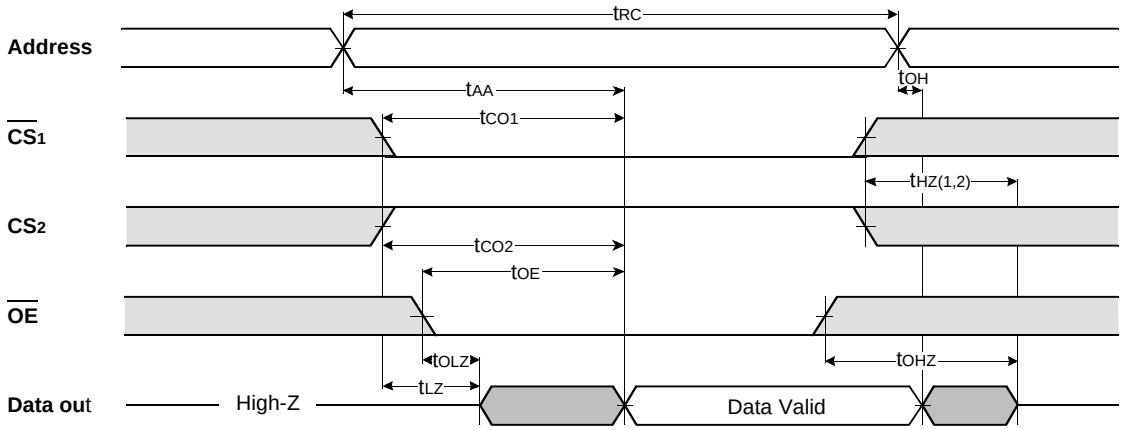
1. $\overline{CS_1}$≥Vcc-0.2V,CS_2≥Vcc-0.2V($\overline{CS_1}$ controlled) or CS_2≥Vcc-0.2V(CS_2 controlled).
2. Super low power product=4μA with special handling.

TIMING DIAGRAMS

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



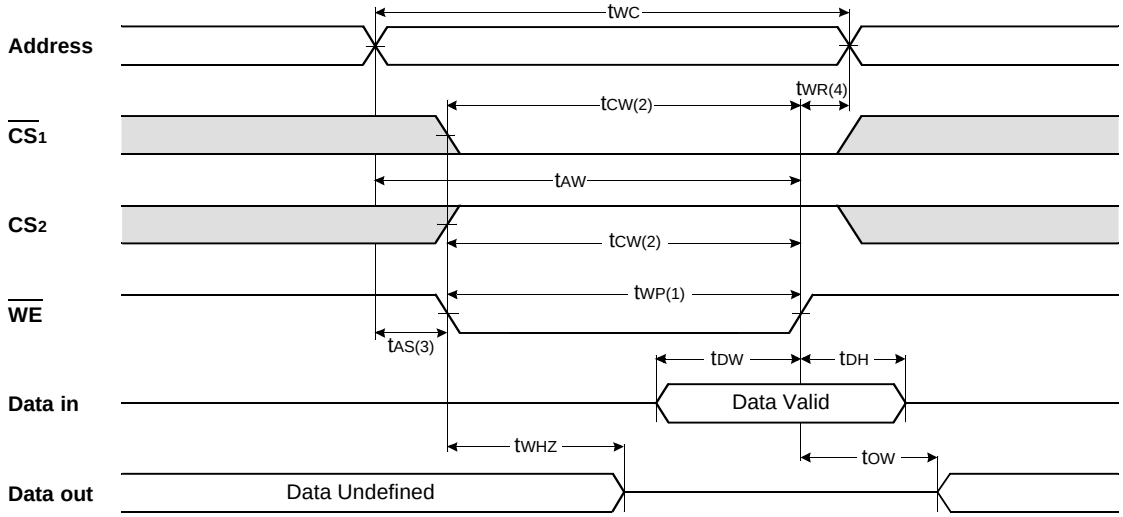
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE}$=V_{IH})



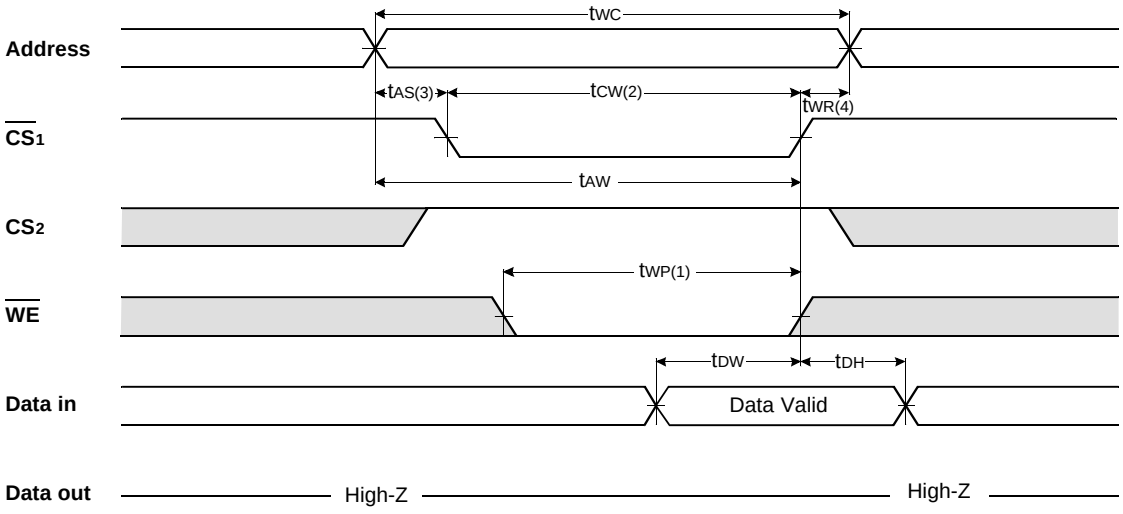
NOTES (READ CYCLE)

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}(Max.) is less than t_{LZ}(Min.) both for a given device and from device to device interconnection.

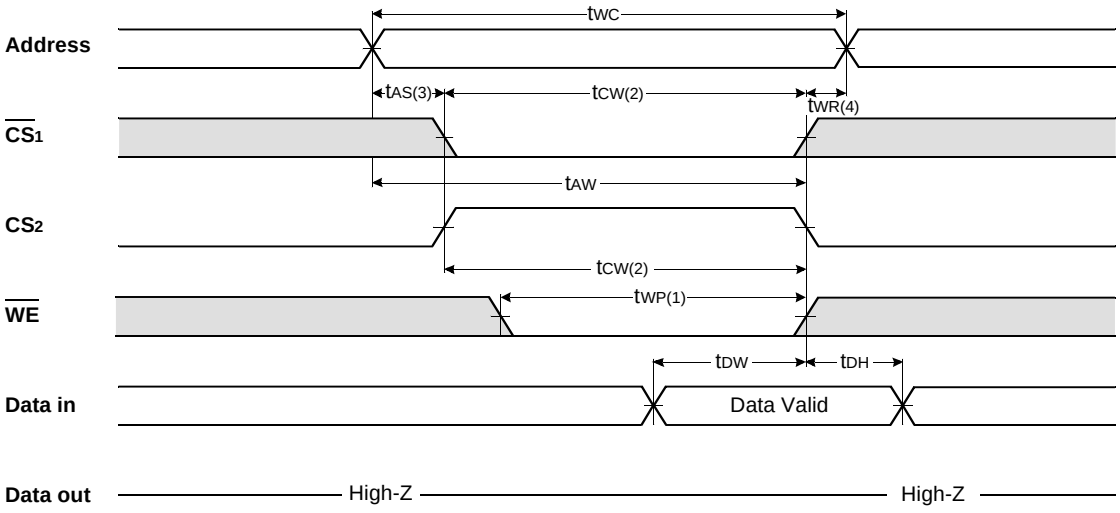
TIMING WAVEFORM OF WRITE CYCLE(1) ($\overline{WE}$ Controlled)



TIMING WAVEFORM OF WRITE CYCLE(2) ($\overline{CS_1}$ Controlled)



TIMING WAVEFORM OF WRITE CYCLE(3) (CS_2 Controlled)

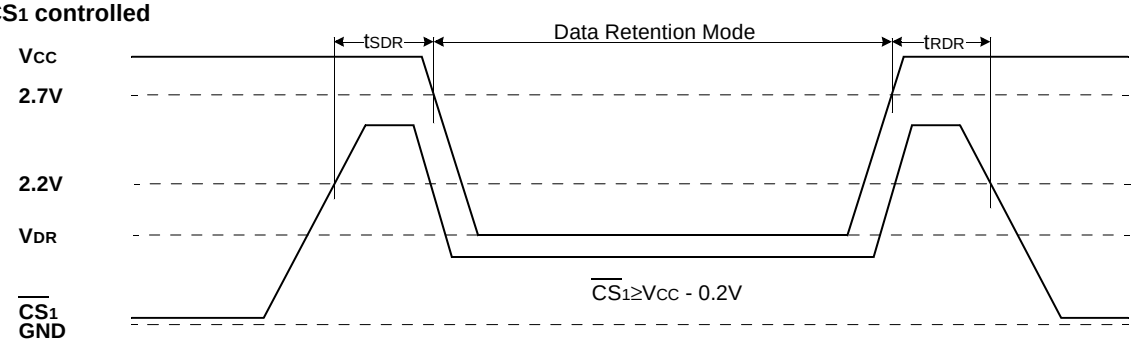


NOTES (WRITE CYCLE)

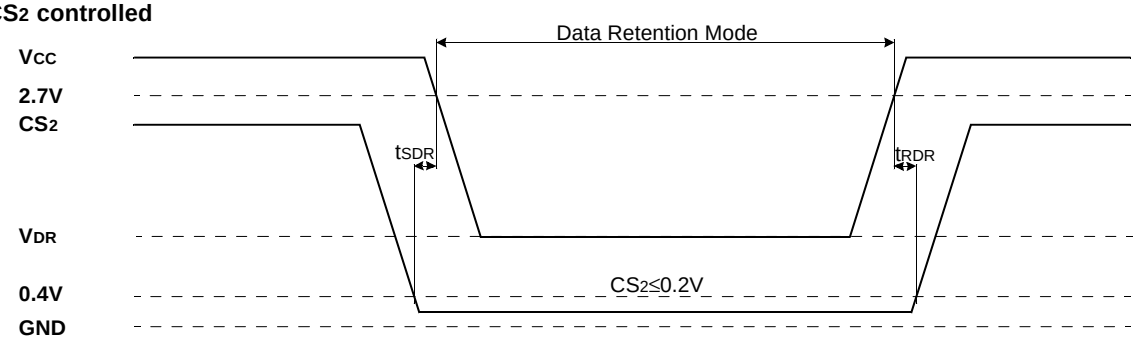
1. A write occurs during the overlap of a low $\overline{CS_1}$, a high CS_2 and a low $\overline{WE}$. A write begins at the latest transition among $\overline{CS_1}$ goes low, CS_2 going high and $\overline{WE}$ going low : A write end at the earliest transition among $\overline{CS_1}$ going high, CS_2 going low and $\overline{WE}$ going high, t_{WP} is measured from the begining of write to the end of write.
2. t_{CW} is measured from the $\overline{CS_1}$ going low or CS_2 going high to the 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 $\overline{CS_1}$ or $\overline{WE}$ going high t_{WR2} applied in case a write ends as CS_2 going to low.

DATA RETENTION WAVE FORM

$\overline{CS_1}$ controlled



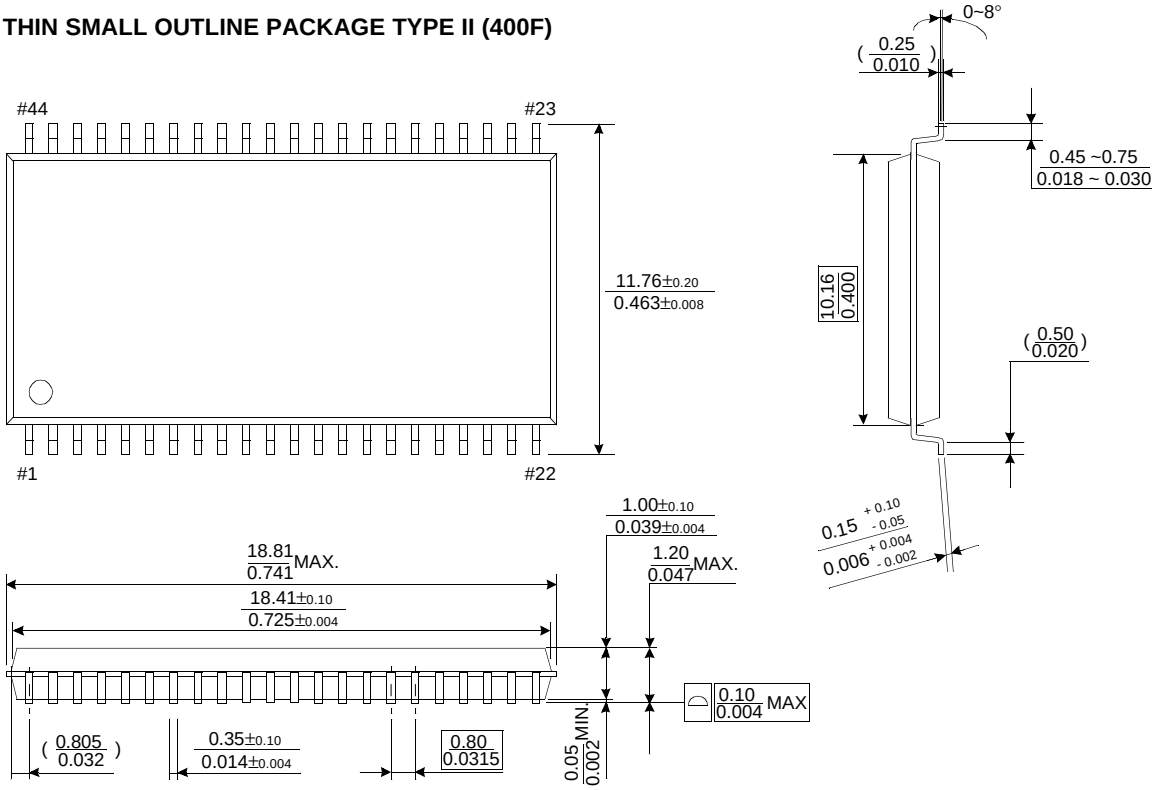
CS_2 controlled



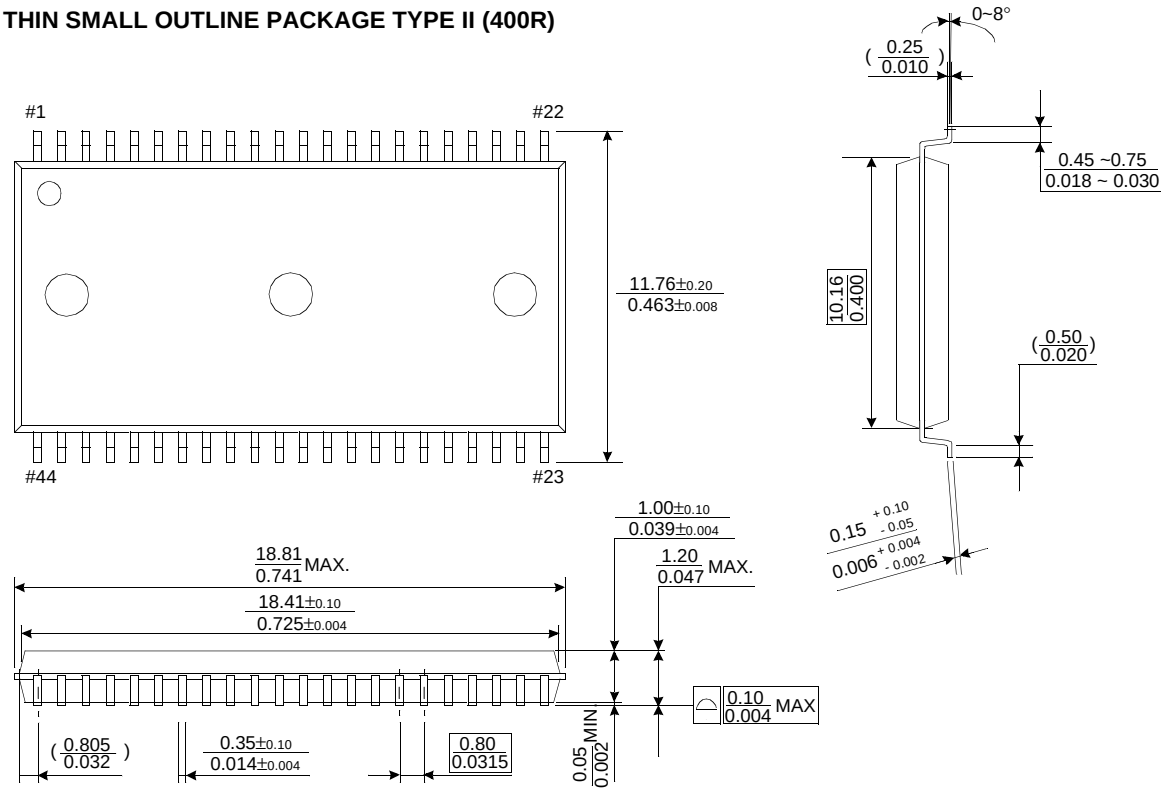
PACKAGE DIMENSIONS

Unit: millimeters(inches)

44 PIN THIN SMALL OUTLINE PACKAGE TYPE II (400F)



44 PIN THIN SMALL OUTLINE PACKAGE TYPE II (400R)

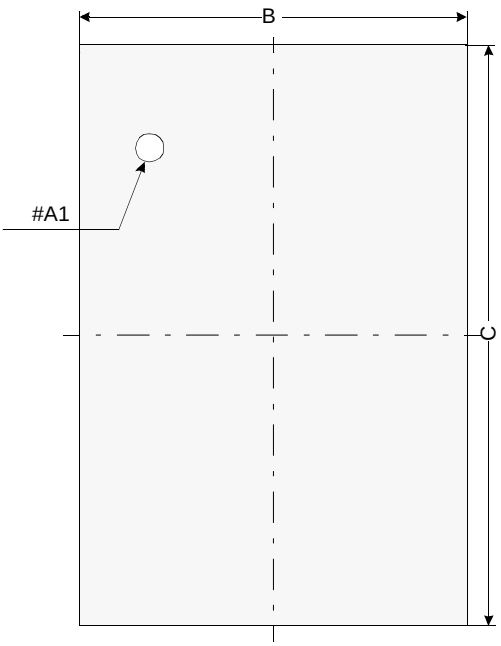


PACKAGE DIMENSION

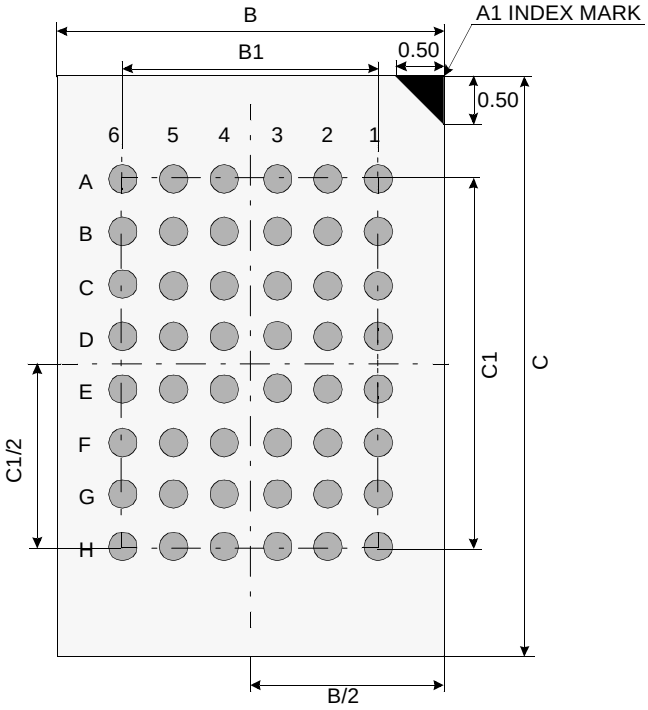
Unit: millimeters

48 BALL FINE PITCH BGA(0.75mm ball pitch)

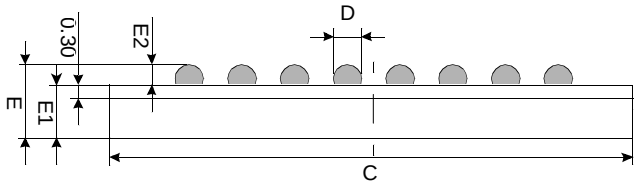
Top View



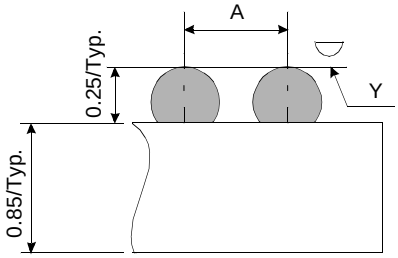
Bottom View



Side View



Detail A



	Min	Typ	Max
A	-	0.75	-
B	7.90	8.00	8.10
B1	-	3.75	-
C	11.90	12.00	12.10
C1	-	5.25	-
D	0.30	0.35	0.40
E	-	1.10	1.20
E1	-	0.85	-
E2	0.20	0.25	0.30
Y	-	-	0.08

Notes.

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