

[Document Title](#)

128K x16 bit Low Power and Low Voltage Full CMOS Static RAM

[Revision History](#)

Revision No.	History	Draft Date	Remark
0.0	Initial Draft	Oct. 31, 2007	
0.1	0.1 Revision	Nov. 16, 2007	

Emerging Memory & Logic Solutions Inc.

4F Korea Construction Financial Cooperative B/D, 301-1 Yeon-Dong, Jeju-Si, Jeju-Do, Rep.of Korea Zip Code : 690-719
Tel : +82-64-740-1712 Fax : +82-64-740-1749~1750 / Homepage : www.emlsi.com

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128K x16 Bit Low Power and Low Voltage CMOS Static RAM

FEATURES

- Process Technology : 0.15mm Full CMOS
- Organization : 128K x16
- Power Supply Voltage
=> EM621FU16BU Series : 2.7V~3.3V
- Low Data Retention Voltage : 1.5V (MIN)
- Three state output and TTL Compatible
- Packaged product designed for 45/55/70ns
- Package Type: 44-TSOP2

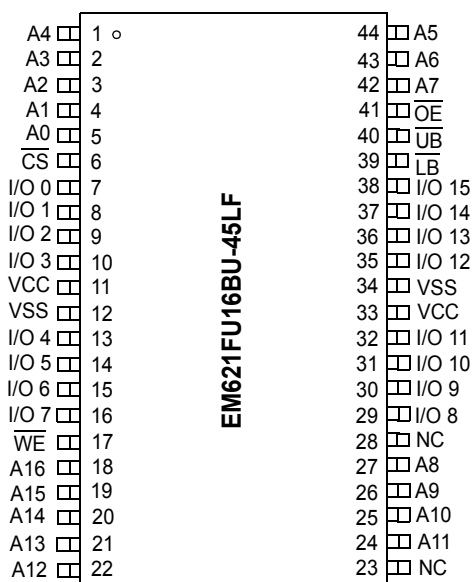
GENERAL DESCRIPTION

The EM621FU16BU series are fabricated by EMLSI's advanced full CMOS process technology. The families support industrial temperature range and Chip Scale Package for user flexibility of system design. The families also supports low data retention voltage for battery back-up operation with low data retention current. The EM621FU16BU series are available in KGD, JEDEC standard 44 pin 400 mil TSOP2 package.

PRODUCT FAMILY

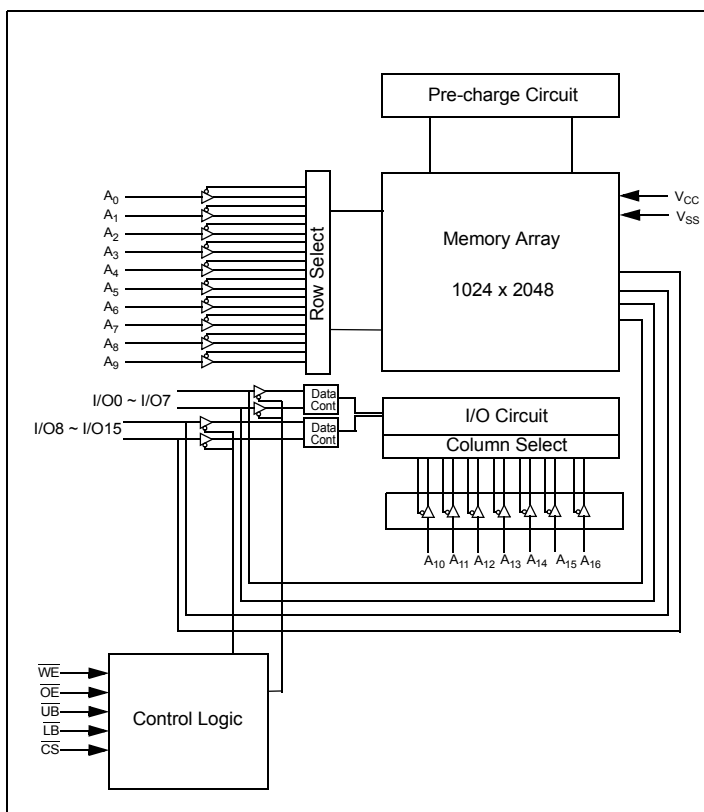
Product Family	Operating Temperature	Vcc Range	Speed	Power Dissipation		PKG Type
				Standby (I _{SB1} , Typ.)	Operating (I _{CC1} -Max)	
EM621FU16BU-45LF	Industrial (-40 ~ 85°C)	2.7V~3.3V	45ns	1 μA	3mA	44-TSOP2
EM621FU16BU-55LF	Industrial (-40 ~ 85°C)	2.7V~3.3V	55ns	1 μA	3mA	44-TSOP2
EM621FU16BU-70LF	Industrial (-40 ~ 85°C)	2.7V~3.3V	70ns	1 μA	3mA	44-TSOP2

PIN DESCRIPTION



Name	Function	Name	Function
\overline{CS}	Chip select inputs	Vcc	Power Supply
\overline{OE}	Output Enable input	Vss	Ground
\overline{WE}	Write Enable input	\overline{UB}	Upper Byte (I/O ₈₋₁₅)
A0~A16	Address Inputs	\overline{LB}	Lower Byte (I/O ₀₋₇)
I/O0~I/O15	Data Inputs/Outputs	NC	No Connection

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS *

Parameter	Symbol	Minimum	Unit
Voltage on Any Pin Relative to Vss	V_{IN}, V_{OUT}	-0.2 to 4.0V	V
Voltage on Vcc supply relative to Vss	V_{CC}	-0.2 to 4.0V	V
Power Dissipation	P_D	1.0	W
Operating Temperature	T_A	-40 to 85	°C

* Stresses greater than those listed above “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.

FUNCTIONAL DESCRIPTION

\overline{CS}	\overline{OE}	\overline{WE}	\overline{LB}	\overline{UB}	I/O ₀₋₇	I/O ₈₋₁₅	Mode	Power
H	X	X	X	X	High-Z	High-Z	Deselected	Stand by
X	X	X	H	H	High-Z	High-Z	Deselected	Stand by
L	H	H	L	X	High-Z	High-Z	Output Disabled	Active
L	H	H	X	L	High-Z	High-Z	Output Disabled	Active
L	L	H	L	H	Data Out	High-Z	Lower Byte Read	Active
L	L	H	H	L	High-Z	Data Out	Upper Byte Read	Active
L	L	H	L	L	Data Out	Data Out	Word Read	Active
L	X	L	L	H	Data In	High-Z	Lower Byte Write	Active
L	X	L	H	L	High-Z	Data In	Upper Byte Write	Active
L	X	L	L	L	Data In	Data In	Word Write	Active

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

RECOMMENDED DC OPERATING CONDITIONS ¹⁾

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V_{CC}	2.7	3.0	3.3	V
Ground	V_{SS}	0	0	0	V
Input high voltage	V_{IH}	2.0	-	$V_{CC} + 0.2^{2)}$	V
Input low voltage	V_{IL}	-0.2 ³⁾	-	0.6	V

1. $T_A = -40$ to 85°C , otherwise specified
2. Overshoot: $V_{CC} + 2.0$ V in case of pulse width ≤ 20 ns
3. Undershoot: -2.0 V in case of pulse width ≤ 20 ns
4. Overshoot and undershoot are sampled, not 100% tested.

CAPACITANCE ¹⁾ ($f=1\text{MHz}$, $T_A=25^\circ\text{C}$)

Item	Symbol	Test Condition	Min	Max	Unit
Input capacitance	C_{IN}	$V_{IN}=0\text{V}$	-	8	pF
Input/Output capacitance	C_{IO}	$V_{IO}=0\text{V}$	-	10	pF

1. Capacitance is sampled, not 100% tested.

DC AND OPERATING CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Input leakage current	I_{LI}	$V_{IN}=V_{SS}$ to V_{CC}	-1	-	1	μA	
Output leakage current	I_{LO}	$\overline{CS}=V_{IH}$ or $\overline{OE}=V_{IH}$ or $\overline{WE}=V_{IL}$ or $\overline{LB}=\overline{UB}=V_{IH}$ $V_{IO}=V_{SS}$ to V_{CC}	-1	-	1	μA	
Operating power supply	I_{CC}	$I_{IO}=0\text{mA}$, $\overline{CS}=V_{IL}$, $V_{IN}=V_{IH}$ or V_{IL}	-	-	3	mA	
Average operating current	I_{CC1}	Cycle time=1 μs , 100% duty, $I_{IO}=0\text{mA}$, $\overline{CS}\leq 0.2\text{V}$, $\overline{LB}\leq 0.2\text{V}$ or/and $\overline{UB}\leq 0.2\text{V}$, $V_{IN}\leq 0.2\text{V}$ or $V_{IN}\geq V_{CC}-0.2\text{V}$	-	-	3	mA	
			45ns	-	-	35	mA
				55ns	-	-	
	I_{CC2}	Cycle time = Min, $I_{IO}=0\text{mA}$, 100% duty, $\overline{CS}=V_{IL}$, $\overline{LB}=V_{IL}$ or/and $\overline{UB}=V_{IL}$, $V_{IN}=V_{IL}$ or V_{IH}	70ns	-	-	25	
Output low voltage	V_{OL}	$I_{OL} = 2.1\text{mA}$	-	-	0.4	V	
Output high voltage	V_{OH}	$I_{OH} = -1.0\text{mA}$	2.4	-	-	V	
Standby Current (TTL)	I_{SB}	$\overline{CS}=V_{IH}$, Other inputs= V_{IH} or V_{IL}	-	-	0.3	mA	
Standby Current (CMOS)	I_{SB1}	$\overline{CS}\geq V_{CC}-0.2\text{V}$, (\overline{CS} controlled) Other inputs = $0\sim V_{CC}$ (Typ. condition : $V_{CC}=3.0\text{V}$ @ 25°C) (Max. condition : $V_{CC}=3.3\text{V}$ @ 85°C)	LF	-	1 ¹⁾	10	μA

NOTES

1. Typical values are measured at $V_{CC}=3.0\text{V}$, $T_A=25^\circ\text{C}$ and not 100% tested.

AC OPERATING CONDITIONS

Test Conditions (Test Load and Test Input/Output Reference)

Input Pulse Level : 0.4V to 2.2V

Input Rise and Fall Time : 5ns

Input and Output reference Voltage : 1.5V

Output Load (See right) : $CL^{(1)} = 100\text{pF} + 1 \text{ TTL (70ns)}$

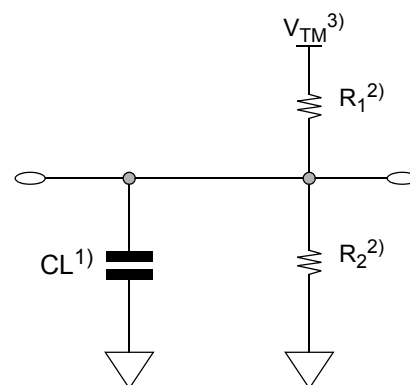
$CL^{(1)} = 30\text{pF} + 1 \text{ TTL (45ns/55ns)}$

1. Including scope and Jig capacitance

2. $R_1=3070 \text{ ohm}$, $R_2=3150 \text{ ohm}$

3. $V_{TM}=2.8\text{V}$

4. $CL = 5\text{pF} + 1 \text{ TTL (measurement with } t_{LZ}, t_{HZ}, t_{OLZ}, t_{OHZ}, t_{WHZ})$



READ CYCLE ($V_{CC} = 2.7\text{V to } 3.3\text{V}$, $Gnd = 0\text{V}$, $T_A = -40^\circ\text{C to } +85^\circ\text{C}$)

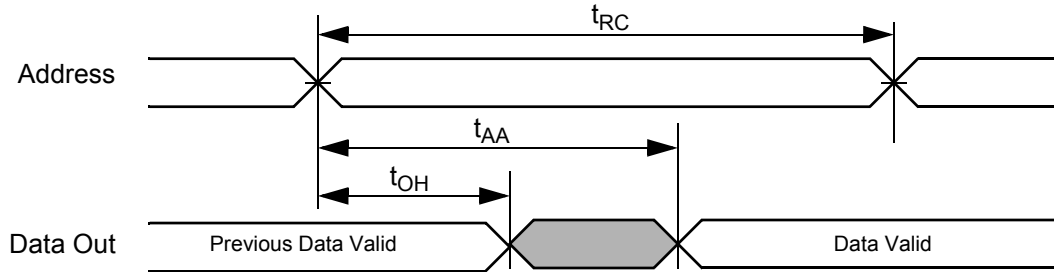
Parameter	Symbol	45ns		55ns		70ns		Unit
		Min	Max	Min	Max	Min	Max	
Read cycle time	t_{RC}	45	-	55	-	70	-	ns
Address access time	t_{AA}	-	45	-	55	-	70	ns
Chip select to output	t_{CO}	-	45	-	55	-	70	ns
Output enable to valid output	t_{OE}	-	25	-	25	-	35	ns
\overline{UB} , \overline{LB} access time	t_{BA}		45		55		70	ns
Chip select to low-Z output	t_{LZ}	10	-	10	-	10	-	ns
\overline{UB} , \overline{LB} enable to low-Z output	t_{BLZ}	5	-	10	-	10	-	ns
Output enable to low-Z output	t_{OLZ}	5	-	5	-	5	-	ns
Chip disable to high-Z output	t_{HZ}	0	20	0	20	0	25	ns
\overline{UB} , \overline{LB} disable to high-Z output	t_{BHZ}	0	15	0	20	0	25	ns
Output disable to high-Z output	t_{OHZ}	0	15	0	20	0	25	ns
Output hold from address change	t_{OH}	10	-	10	-	10	-	ns

WRITE CYCLE ($V_{CC} = 2.7\text{V to } 3.3\text{V}$, $Gnd = 0\text{V}$, $T_A = -40^\circ\text{C to } +85^\circ\text{C}$)

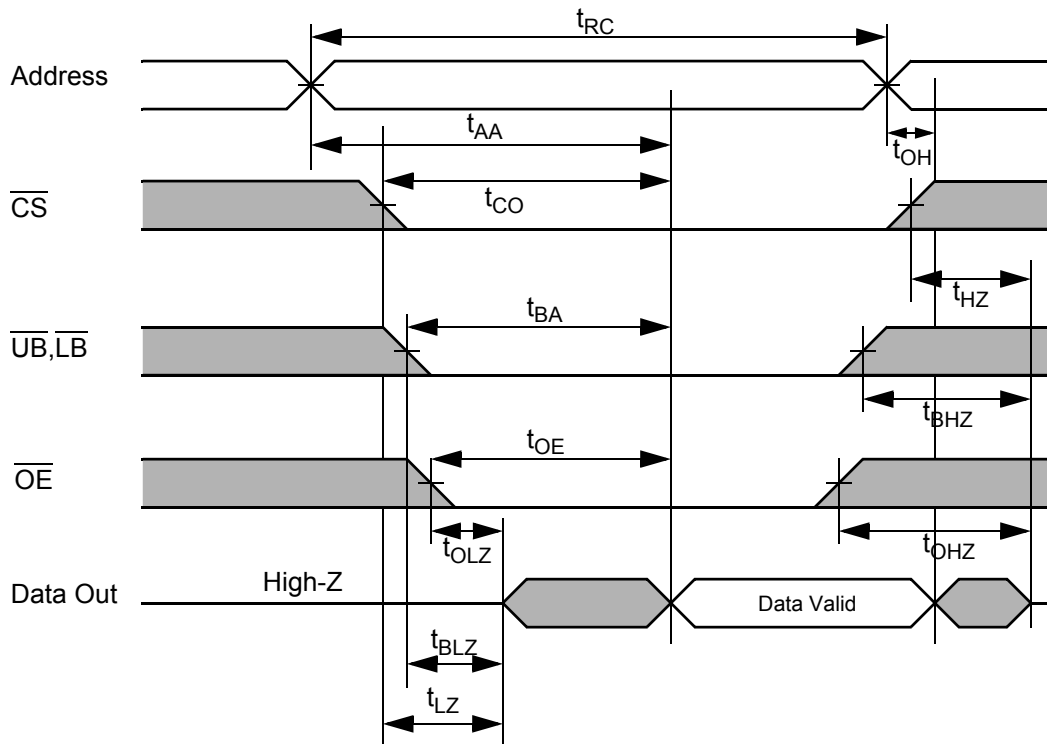
Parameter	Symbol	45ns		55ns		70ns		Unit
		Min	Max	Min	Max	Min	Max	
Write cycle time	t_{WC}	45	-	55	-	70	-	ns
Chip select to end of write	t_{CW}	45	-	45	-	60	-	ns
Address setup time	t_{AS}	0	-	0	-	0	-	ns
Address valid to end of write	t_{AW}	45	-	45	-	60	-	ns
\overline{UB} , \overline{LB} valid to end of write	t_{BW}	45	-	45	-	60	-	ns
Write pulse width	t_{WP}	35	-	40	-	50	-	ns
Write recovery time	t_{WR}	0	-	0	-	0	-	ns
Write to output high-Z	t_{WHZ}	0	15	0	20	0	20	ns
Data to write time overlap	t_{DW}	25		25		30		ns
Data hold from write time	t_{DH}	0	-	0	-	0	-	ns
End write to output low-Z	t_{OW}	5	-	5	-	5	-	ns

TIMING DIAGRAMS

TIMING WAVEFORM OF READ CYCLE(1). (Address Controlled, $\overline{CS}=\overline{OE}=V_{IL}$, \overline{UB} or/and $\overline{LB}=V_{IL}$)



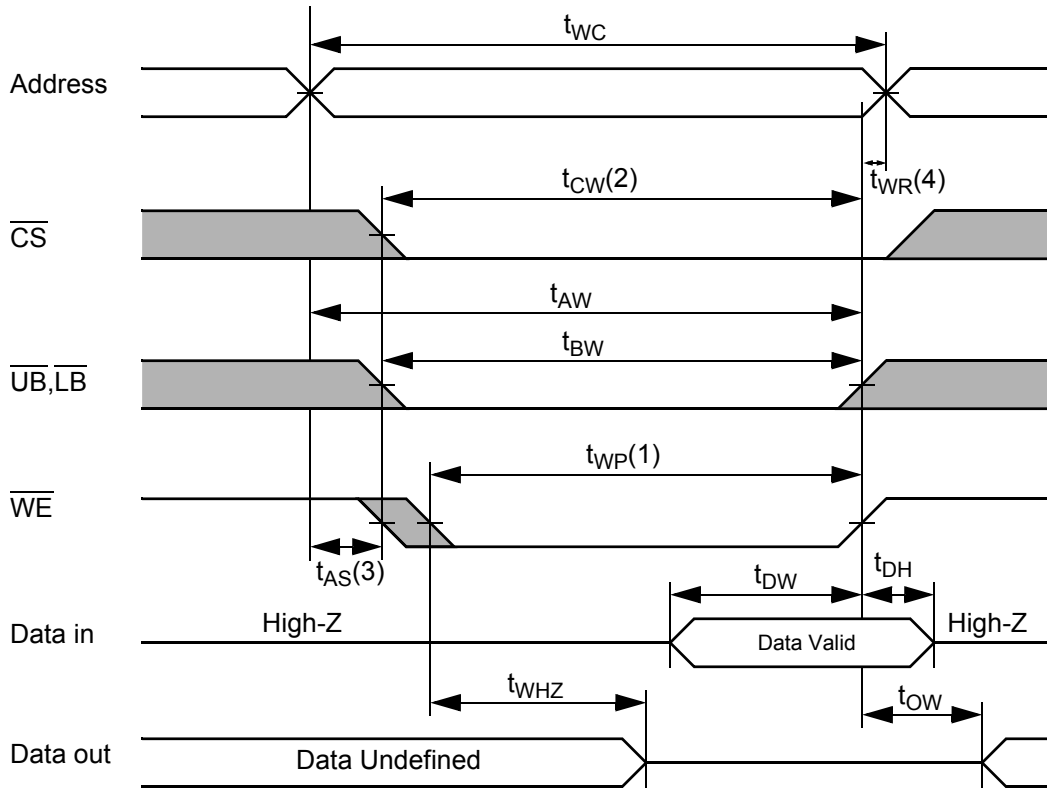
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE} = V_{IH}$)



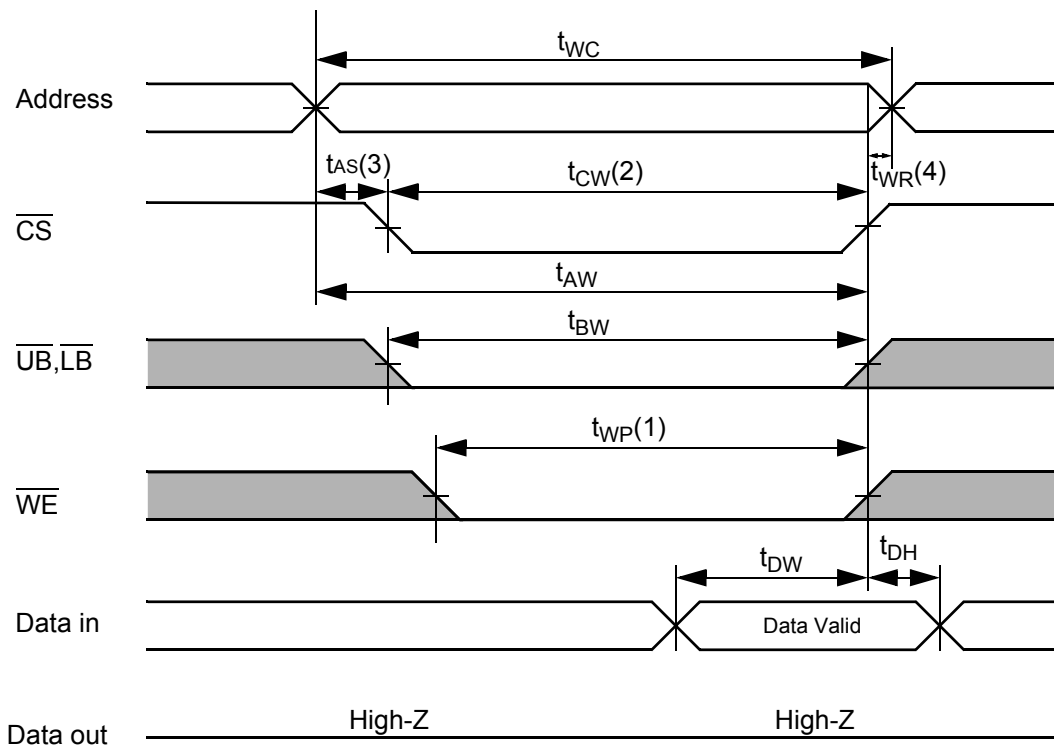
NOTES (READ CYCLE)

- t_{HZ} and t_{OHZ} are defined as the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
- 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 interconnection.

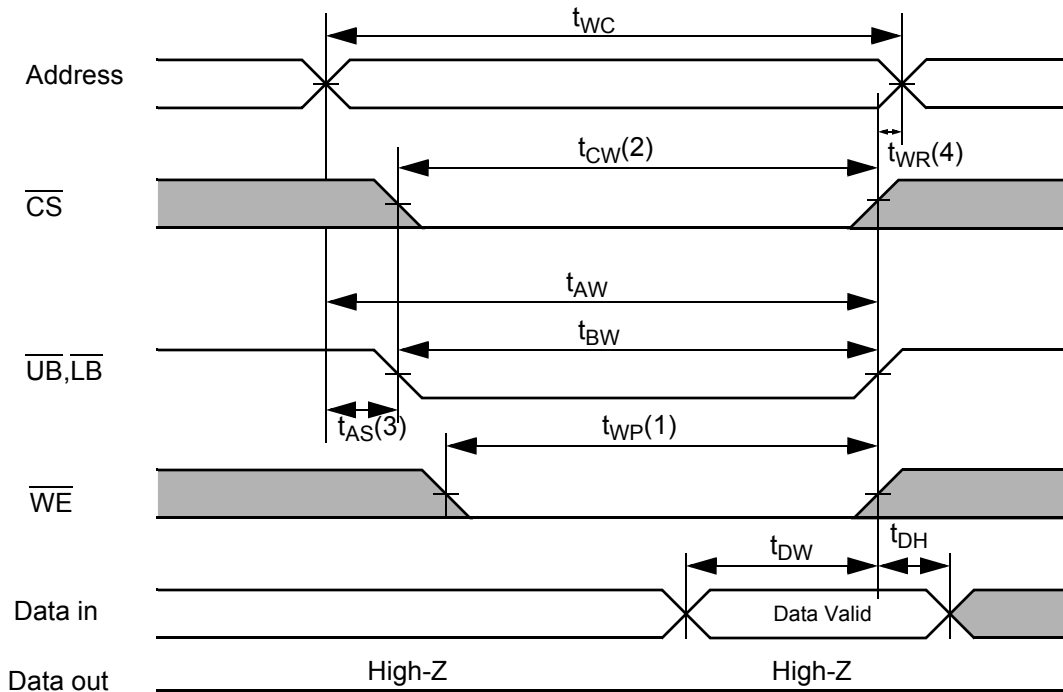
TIMING WAVEFORM OF WRITE CYCLE(1) (\overline{WE} CONTROLLED)



TIMING WAVEFORM OF WRITE CYCLE(2) (\overline{CS} CONTROLLED)



TIMING WAVEFORM OF WRITE CYCLE(3) (\overline{UB} , \overline{LB} CONTROLLED)



NOTES (WRITE CYCLE)

1. A write occurs during the overlap(t_{WP}) of low \overline{CS} and low \overline{WE} . A write begins when \overline{CS} goes low and \overline{WE} goes low with asserting \overline{UB} or \overline{LB} for single byte operation or simultaneously asserting \overline{UB} and \overline{LB} for double byte operation. A write ends at the earliest transition when \overline{CS} goes high and \overline{WE} goes high. The t_{WP} is measured from the beginning of write to the end of write.
2. t_{CW} is measured from the \overline{CS} going low to 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} or \overline{WE} going high.

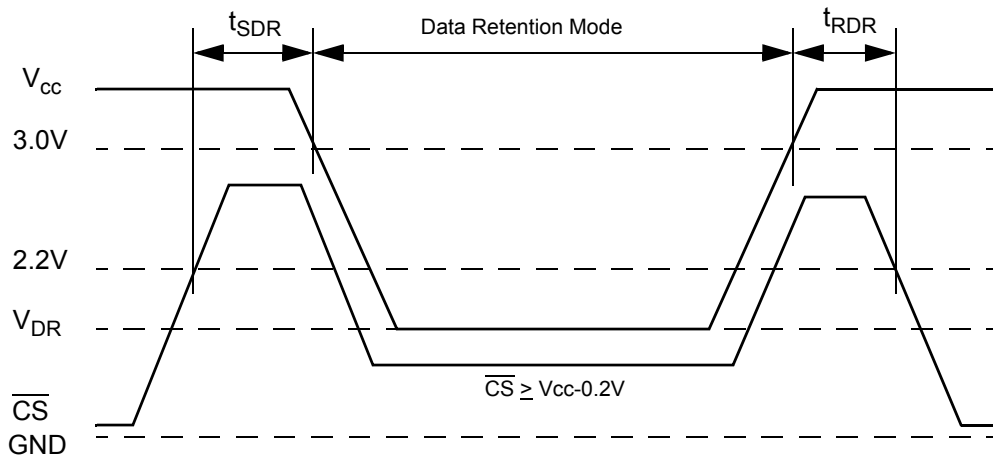
DATA RETENTION CHARACTERISTICS

Parameter	Symbol	Test Condition	Min	Typ ²⁾	Max	Unit
V _{CC} for Data Retention	V _{DR}	I _{SB1} Test Condition (Chip Disabled) ¹⁾	1.5	-	3.3	V
Data Retention Current	I _{DR}	V _{CC} =1.5V, I _{SB1} Test Condition (Chip Disabled) ¹⁾	-	0.5	5.0	μA
Chip Deselect to Data Retention Time	t _{SDR}	See data retention wave form	0	-	-	ns
Operation Recovery Time	t _{RDR}		t _{RC}	-	-	

NOTES

1. See the I_{SB1} measurement condition of data sheet page 4.
2. Typical value is measured at T_A=25°C and not 100% tested.

DATA RETENTION WAVE FORM

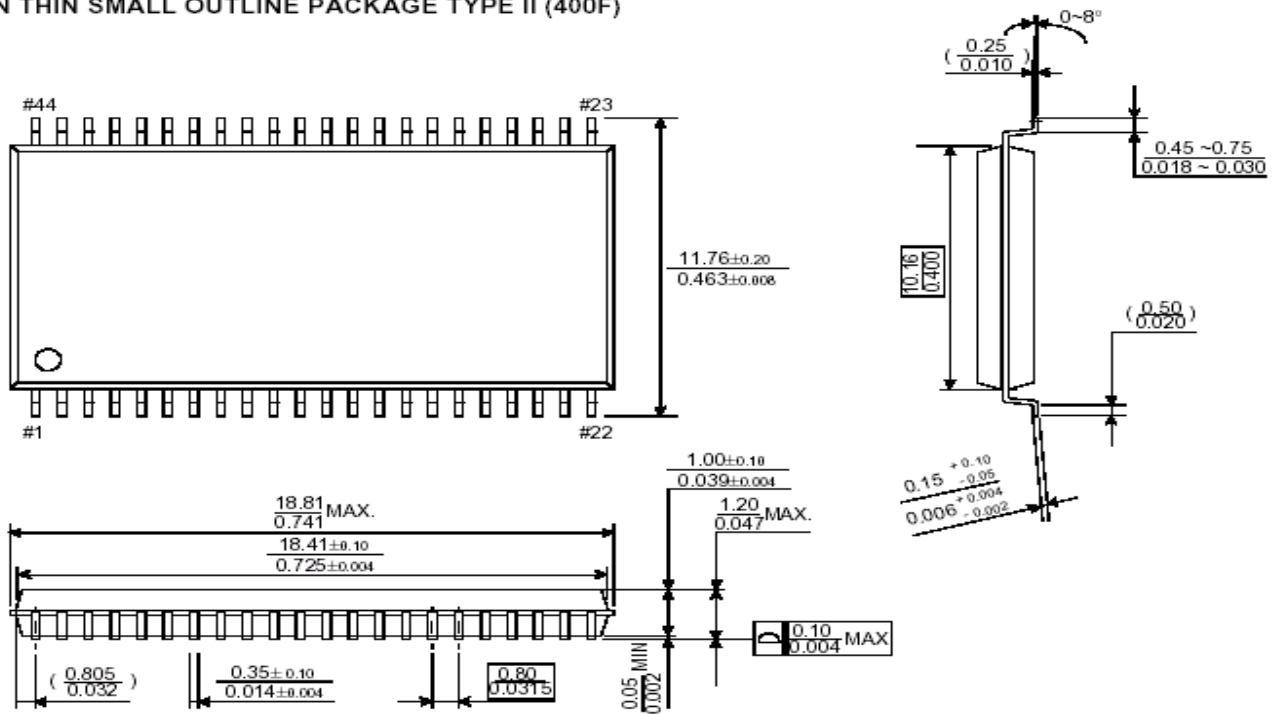


PACKAGE DIMENSIONS

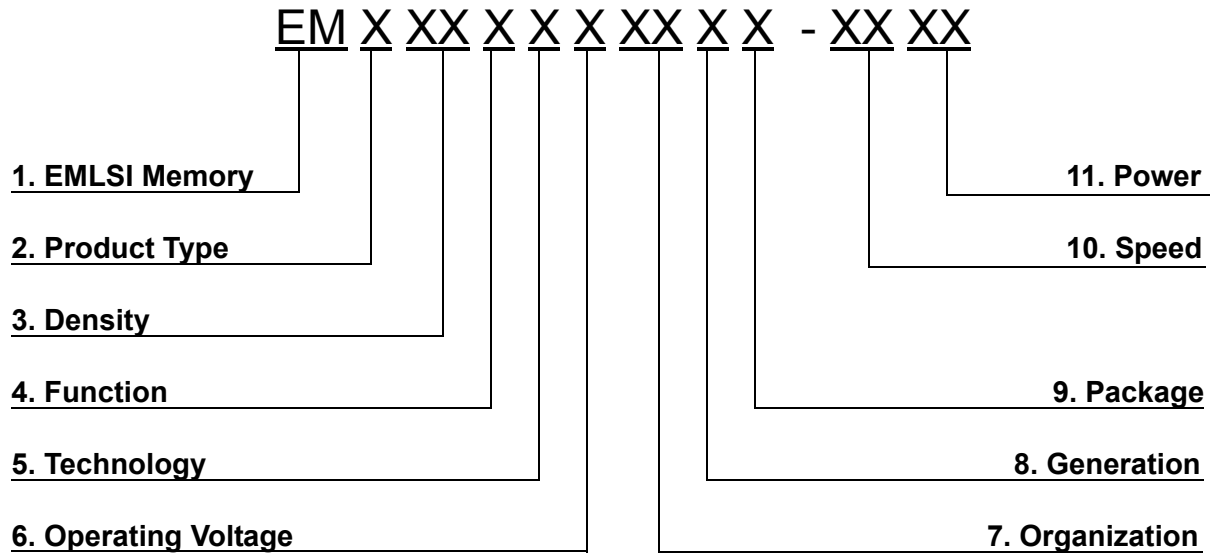
44Pin - TSOP Type2

Unit : millimeters/Inches

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



SRAM PART CODING SYSTEM



- 1. Memory Component
EM ----- Memory
- 2. Product Type
6 ----- SRAM
- 3. Density
1 ----- 1M
2 ----- 2M
4 ----- 4M
8 ----- 8M
- 4. Function
0 ----- Dual CS
1 ----- Single CS
2 ----- Multiplexed
3 ----- Single CS / LBB, UBB(tBA=tOE)
4 ----- Single CS / LBB, UBB(tBA=tCO)
5 ----- Dual CS / LBB, UBB(tBA=tOE)
6 ----- Dual CS / LBB, UBB(tBA=tCO)
- 5. Technology
F ----- Full CMOS
- 6. Operating Voltage
T ----- 5.0V
V ----- 3.3V
U ----- 3.0V
S ----- 2.5V
R ----- 2.0V
P ----- 1.8V

- 7. Organization
8 ----- x8 bit
16 ----- x16 bit
- 8. Generation
Blank ----- 1st generation
A ----- 2nd generation
B ----- 3rd generation
C ----- 4th generation
D ----- 5th generation
E ----- 6th generation
F ----- 7th generation
G ----- 8th generation
- 9. Package
Blank ----- KGD, 48&36FpBGA
S ----- 32 sTSOP1
T ----- 32 TSOP1
U ----- 44 TSOP2
V ----- 32 SOP
- 10. Speed
45 ----- 45ns
55 ----- 55ns
70 ----- 70ns
85 ----- 85ns
10 ----- 100ns
12 ----- 120ns
- 11. Power
LL ----- Low Low Power
LF ----- Low Low Power(Pb-Free & Green)
L ----- Low Power
S ----- Standard Power