

Document Title

256K x8 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 Fix typo error | 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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256K x8 Bit Low Power and Low Voltage CMOS Static RAM

FEATURES

- Process Technology : 0.15mm Full CMOS
- Organization :256K x8
- Power Supply Voltage
=> EM620FU8BS 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: 32-TSOP1

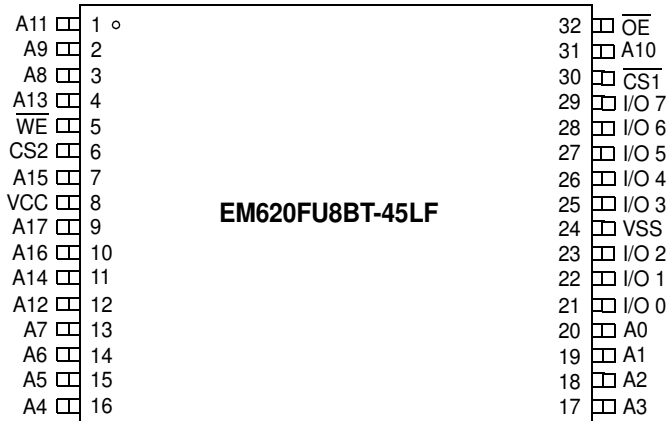
GENERAL DESCRIPTION

The EM620FU8BT 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 EM620FU8BT series are available in KGD, JEDEC standard 32 pin 8mm x 20mm TSOP.

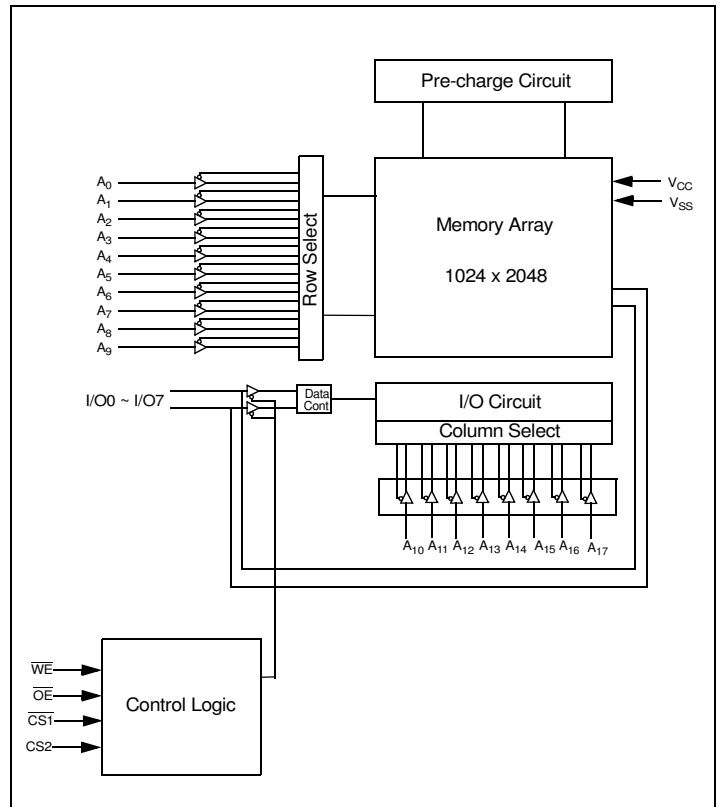
PRODUCT FAMILY

| Product Family | Operating Temperature | Vcc Range | Speed | Power Dissipation | | PKG Type |
|-----------------|-------------------------|-----------|-------|-----------------------------------|-----------------------------------|----------|
| | | | | Standby (I _{SB1} , Typ.) | Operating (I _{CC1} -Max) | |
| EM620FU8BT-45LF | Industrial (-40 ~ 85°C) | 2.7V~3.3V | 45ns | 1μA | 3mA | 32-TSOP1 |
| EM620FU8BT-55LF | Industrial (-40 ~ 85°C) | 2.7V~3.3V | 55ns | 1μA | 3mA | 32-TSOP1 |
| EM620FU8BT-70LF | Industrial (-40 ~ 85°C) | 2.7V~3.3V | 70ns | 1μA | 3mA | 32-TSOP1 |

PIN DESCRIPTION



FUNCTIONAL BLOCK DIAGRAM



| Name | Function | Name | Function |
|-----------|---------------------|------|---------------|
| CS1, CS2 | Chip select inputs | Vcc | Power Supply |
| OE | Output Enable input | Vss | Ground |
| WE | Write Enable input | NC | No Connection |
| A0~A17 | Address Inputs | | |
| I/O0~I/O7 | Data Inputs/Outputs | | |

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

| $\overline{CS1}$ | $CS2$ | \overline{OE} | \overline{WE} | I/O ₀₋₇ | Mode | Power |
|------------------|-------|-----------------|-----------------|--------------------|-----------------|----------|
| H | X | X | X | High-Z | Deselected | Stand by |
| X | L | X | X | High-Z | Deselected | Stand by |
| L | H | H | H | High-Z | Output Disabled | Active |
| L | H | L | H | Data Out | Read | Active |
| L | H | X | L | Data In | 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} | $\overline{CS1} = V_{IH}$ or $CS2 = V_{IL}$ or $\overline{OE} = V_{IH}$ or $\overline{WE} = V_{IL}$ $V_{IO} = V_{SS}$ to V_{CC} | -1 | - | 1 | μA | |
| Operating power supply | I_{CC} | $I_{IO} = 0\text{mA}$, $\overline{CS1} = V_{IL}$, $CS2 = \overline{WE} = V_{IH}$, $V_{IN} = V_{IH}$ or V_{IL} | - | - | 3 | mA | |
| Average operating current | I_{CC1} | Cycle time = $1\mu\text{s}$, 100% duty, $I_{IO} = 0\text{mA}$, $\overline{CS1} \leq 0.2\text{V}$, $CS2 \geq V_{CC} - 0.2\text{V}$, $V_{IN} \leq 0.2\text{V}$ or $V_{IN} \geq V_{CC} - 0.2\text{V}$ | - | - | 3 | mA | |
| | I_{CC2} | Cycle time = Min, $I_{IO} = 0\text{mA}$, 100% duty, $\overline{CS1} = V_{IL}$, $CS2 = V_{IH}$, $V_{IN} = V_{IL}$ or V_{IH} | 45ns | - | - | 35 | mA |
| | | | 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} | $\overline{CS1} = V_{IH}$, $CS2 = V_{IL}$, Other inputs = V_{IH} or V_{IL} | - | - | 0.3 | mA | |
| Standby Current (CMOS) | I_{SB1} | $\overline{CS1} \geq V_{CC} - 0.2\text{V}$, $CS2 \geq V_{CC} - 0.2\text{V}$ ($\overline{CS1}$ controlled) or $0\text{V} \leq CS2 \leq 0.2\text{V}$ ($CS2$ 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) : $CL^{(1)} = 100\text{pF} + 1 \text{ TTL (70ns)}$

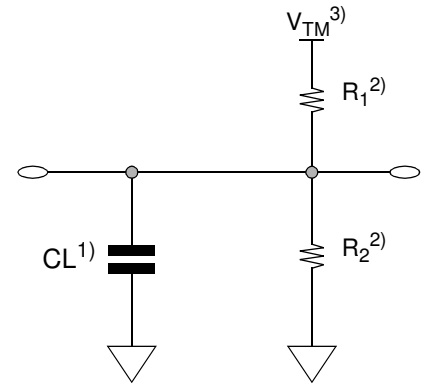
$CL^{(1)} = 30\text{pF} + 1 \text{ TTL (45ns/55ns)}$

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. $CL = 5\text{pF} + 1 \text{ TTL (measurement with } t_{LZ1,2}, t_{HZ1,2}, t_{OLZ}, t_{OHZ}, t_{WHZ})$



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

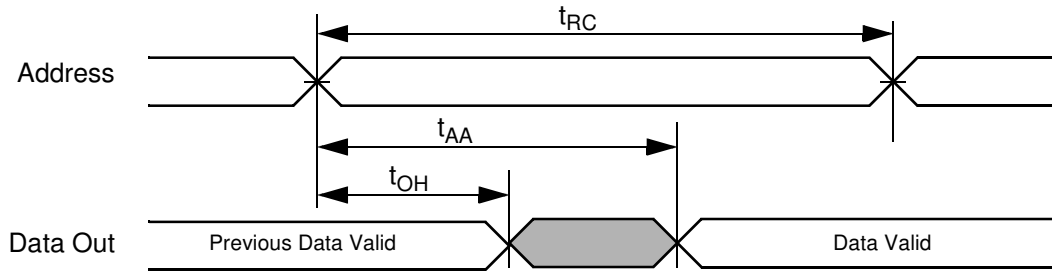
| Parameter | Symbol | 45ns | | 55ns | | 70ns | | Unit |
|---------------------------------|--------------------|------|-----|------|-----|------|-----|------|
| | | Min | Max | Min | Max | Min | Max | |
| Read cycle time | t_{RC} | 45 | - | 55 | - | 70 | - | ns |
| Address access time | t_{AA} | - | 45 | - | 55 | - | 70 | ns |
| Chip select to output | t_{CO1}, t_{CO2} | - | 45 | - | 55 | - | 70 | ns |
| Output enable to valid output | t_{OE} | - | 25 | - | 25 | - | 35 | ns |
| Chip select to low-Z output | t_{LZ1}, t_{LZ2} | 10 | - | 10 | - | 10 | - | ns |
| Output enable to low-Z output | t_{OLZ} | 5 | - | 5 | - | 5 | - | ns |
| Chip disable to high-Z output | t_{HZ1}, t_{HZ2} | 0 | 20 | 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 ($V_{CC} = 2.7\text{V to } 3.3\text{V}$, $Gnd = 0\text{V}$, $T_A = -40^\circ\text{C to } +85^\circ\text{C}$)

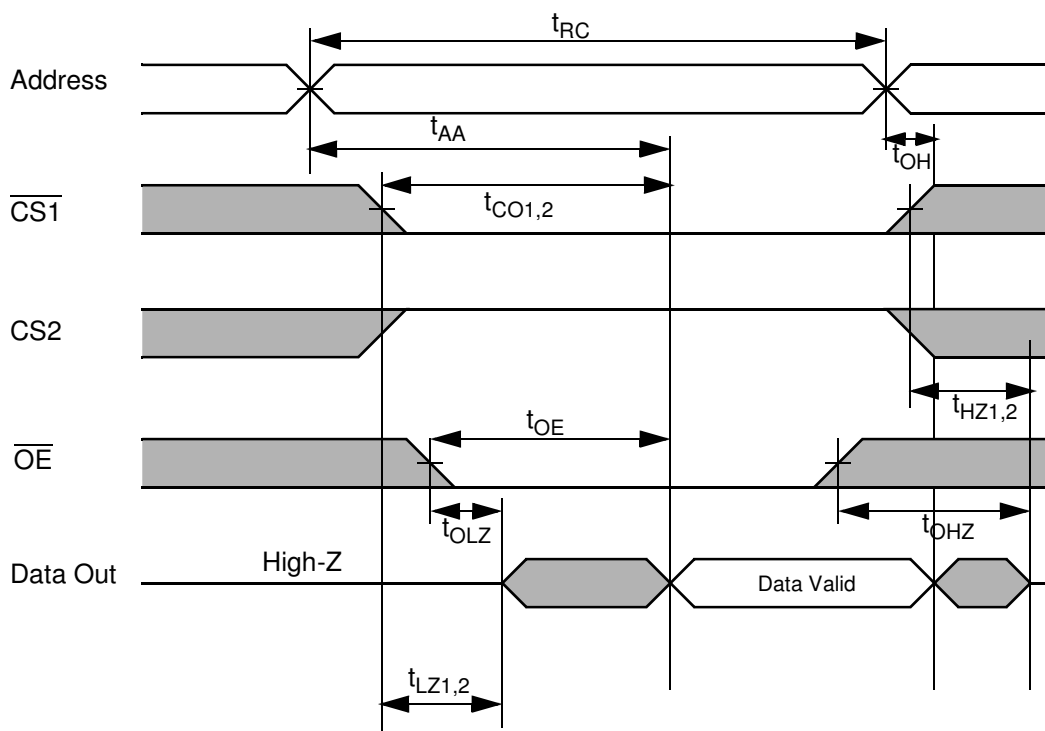
| Parameter | Symbol | 45ns | | 55ns | | 70ns | | Unit |
|-------------------------------|--------------------|------|-----|------|-----|------|-----|------|
| | | Min | Max | Min | Max | Min | Max | |
| Write cycle time | t_{WC} | 45 | - | 55 | - | 70 | - | ns |
| Chip select to end of write | t_{CW1}, t_{CW2} | 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 |
| 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, $\overline{CS1}=\overline{OE}=V_{IL}$, $CS2=\overline{WE}=V_{IH}$)



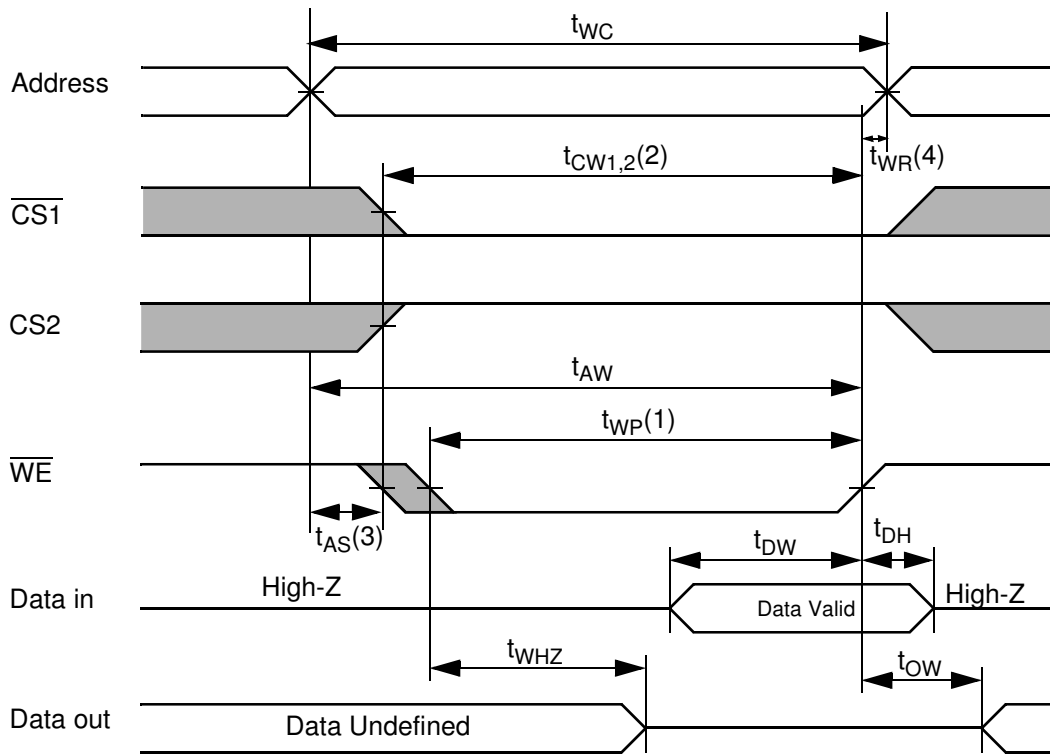
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE} = V_{IH}$)



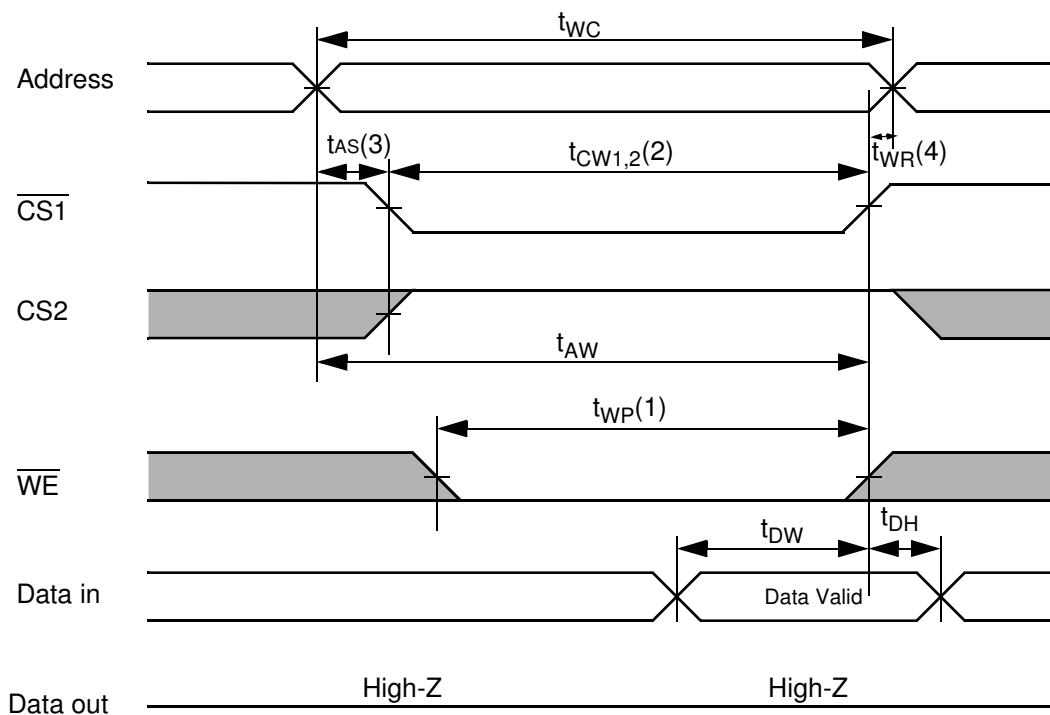
NOTES (READ CYCLE)

1. $t_{HZ1,2}$ and t_{OHZ} are defined as the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
2. At any given temperature and voltage condition, $t_{HZ1,2}(\text{Max.})$ is less than $t_{LZ1,2}(\text{Min.})$ both for a given device and from device to device interconnection.

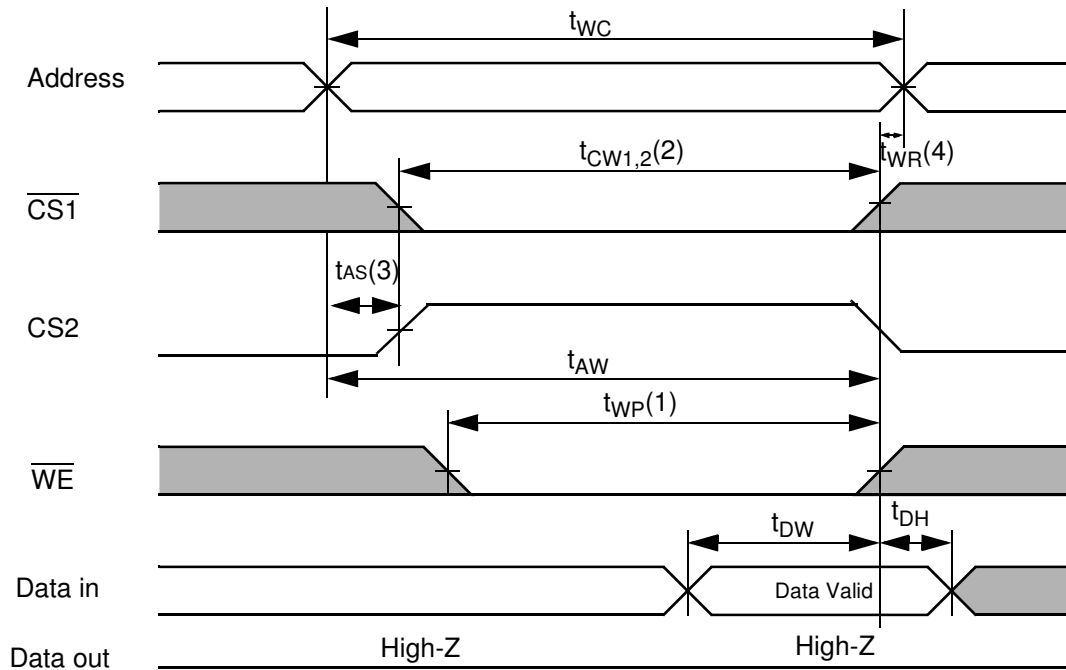
TIMING WAVEFORM OF WRITE CYCLE(1) (\overline{WE} CONTROLLED)



TIMING WAVEFORM OF WRITE CYCLE(2) ($\overline{CS1}$ CONTROLLED)



TIMING WAVEFORM OF WRITE CYCLE(3) (CS2 CONTROLLED)



NOTES (WRITE CYCLE)

1. A write occurs during the overlap(t_{WP}) of low $\overline{CS1}$, a high CS2 and low \overline{WE} . A write begins at the latest transition among $\overline{CS1}$ goes low, CS2 goes high and \overline{WE} goes low. A write ends at the earliest transition among $\overline{CS1}$ goes high, CS2 goes low 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 $\overline{CS1}$ going low or CS2 going high 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 $\overline{CS1}$ or \overline{WE} going high or CS2 going low.

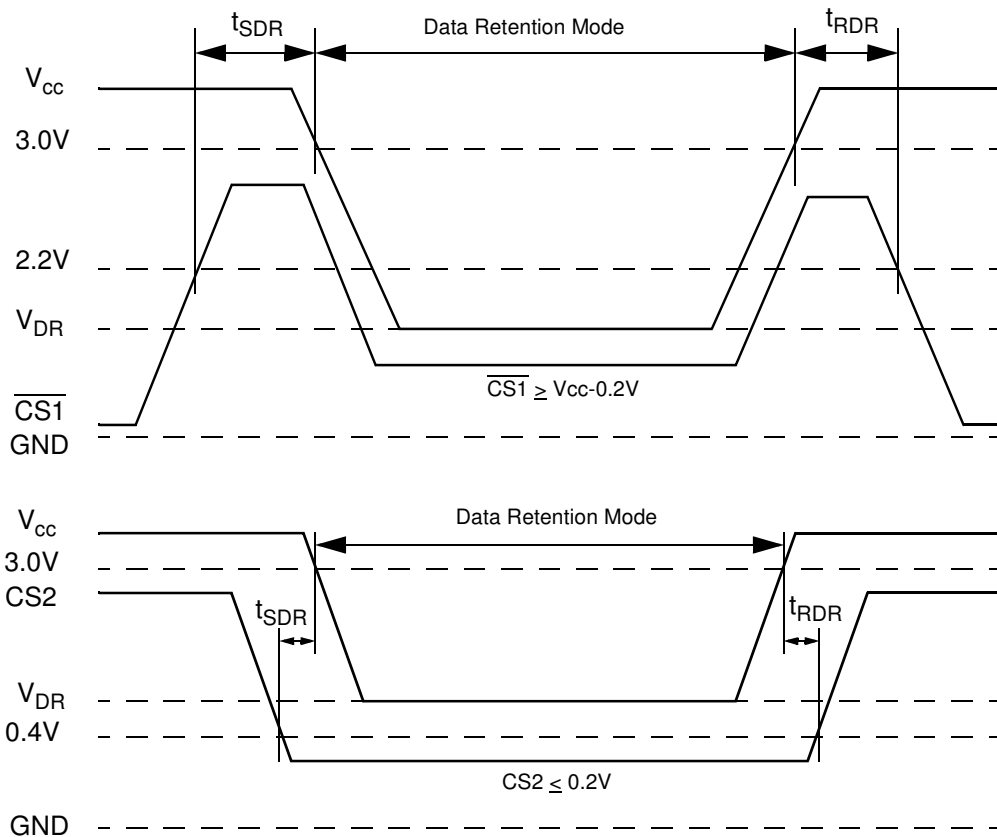
DATA RETENTION CHARACTERISTICS

| 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

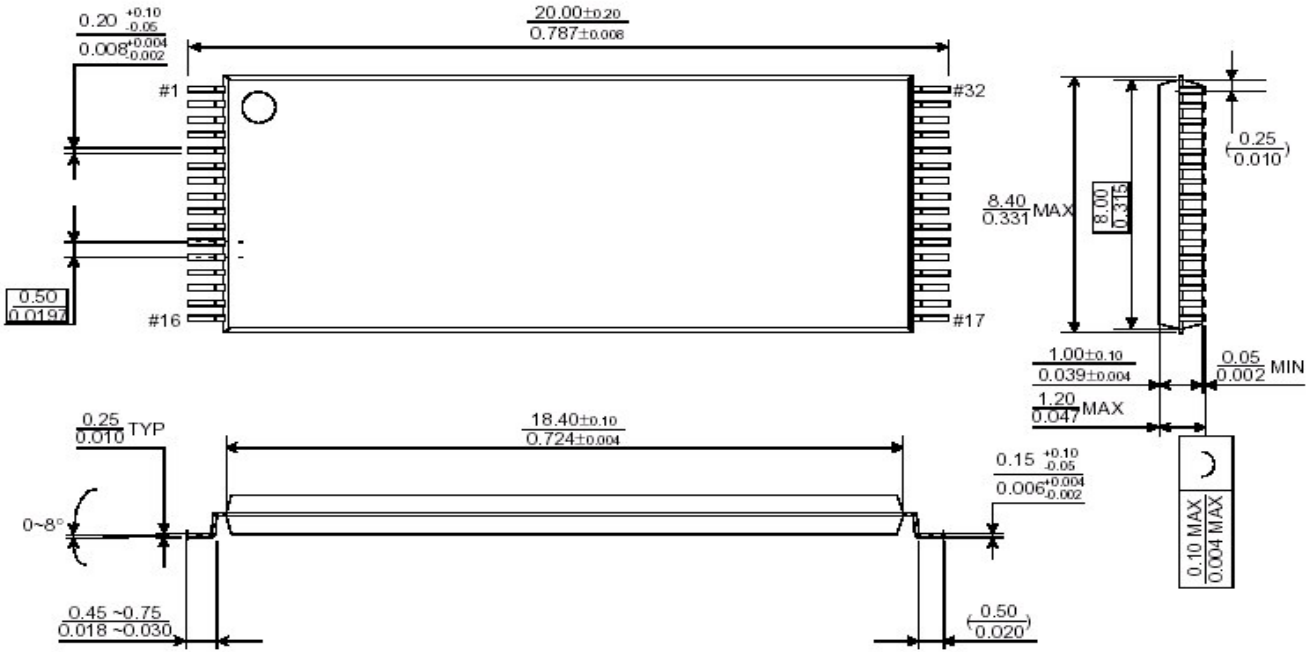


PACKAGE DIMENSIONS

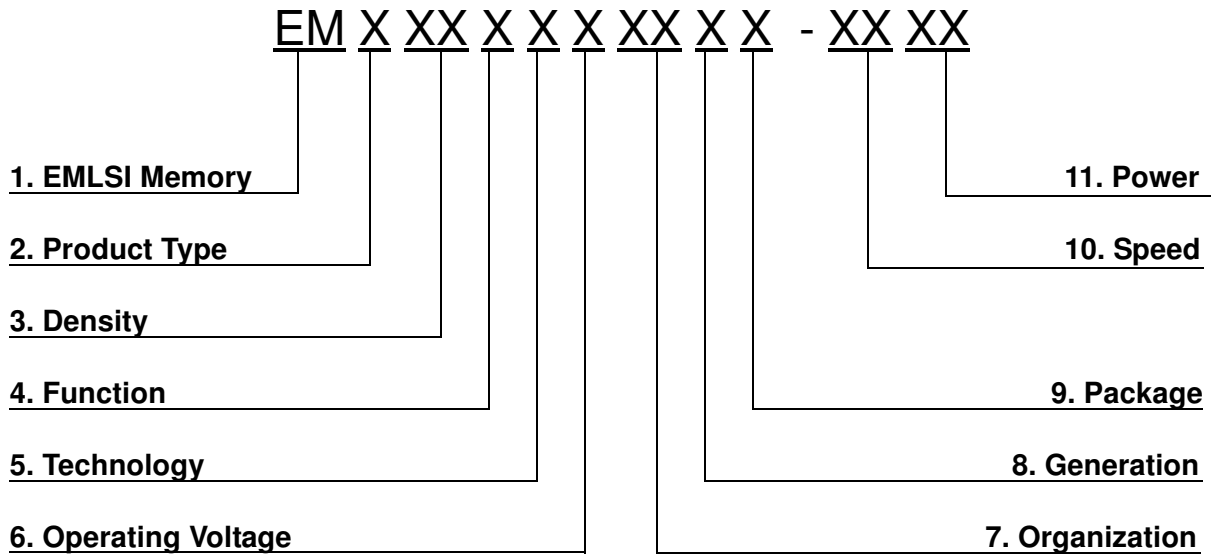
32Pin - TSOP Type1

Unit : millimeters/Inches

32 PIN THIN SMALL OUTLINE PACKAGE TYPE I (0820F)



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 TSOP

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