

PSRAM

4-Mbit (512K x 8)

Pseudo Static RAM

Features

- Advanced low power architecture
- High speed: 55 ns, 60 ns and 70 ns
- Wide voltage range: 2.7V to 3.6V
- Typical active current: 1mA @ f = 1 MHz
- Low standby power
- Automatic power-down when deselected

Functional Description

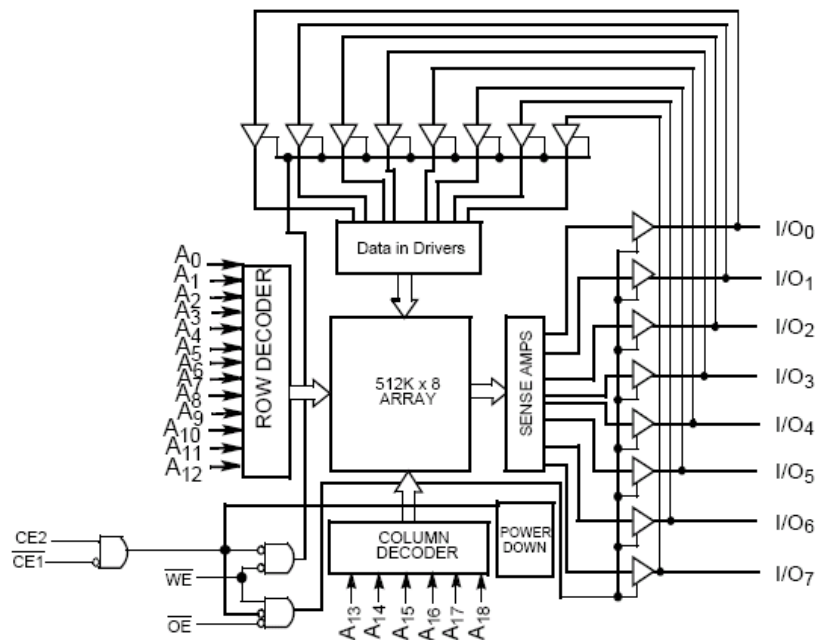
The M24L48512DA is a high-performance CMOS pseudo static RAM (PSRAM) organized as 512K words by 8 bits. Easy memory expansion is provided by an active LOW Chip Enable ($\overline{CE1}$), an active HIGH Chip Enable (CE2), and active LOW Output Enable (\overline{OE}). This device has an automatic power-down feature that reduces power consumption dramatically when deselected. Writing to the device is accomplished by taking Chip Enable One ($\overline{CE1}$) and Write

Enable (\overline{WE}) inputs LOW and Chip Enable Two (CE2) input HIGH. Data on the eight I/O pins (I/O_0 through I/O_{15}) is then written into the location specified on the address pins (A_0 through A_{18}).

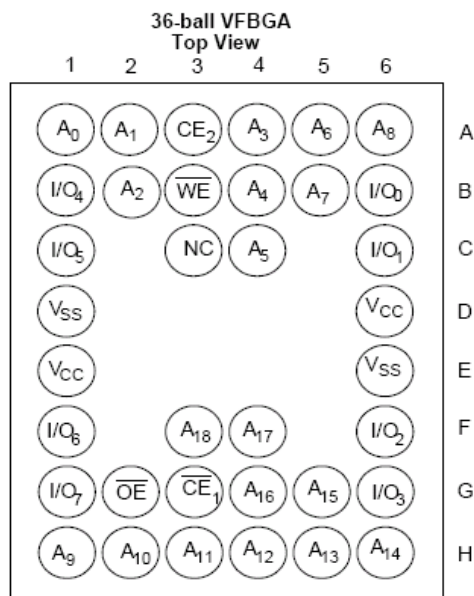
Reading from the device is accomplished by asserting the Chip Enable One ($\overline{CE1}$) and Output Enable (\overline{OE}) inputs LOW while forcing Write Enable (\overline{WE}) HIGH and Chip Enable Two (CE2) HIGH. Under these conditions, the contents of the memory location specified by the address pins will appear on the I/O pins.

The eight input/output pins (I/O_0 through I/O_7) are placed in a high-impedance state when the device is deselected ($\overline{CE1}$ HIGH or CE2 LOW), the outputs are disabled (\overline{OE} HIGH), or during write operation ($\overline{CE1}$ LOW, CE2 HIGH, and \overline{WE} LOW). See the Truth Table for a complete description of read and write modes.

Logic Block Diagram



Pin Configuration[1]



Product Portfolio

Product	V _{CC} Range(V)			Speed (ns)	Power Dissipation					
					Operating, I _{CC} (mA)				Standby, I _{SB2} (μA)	
	f = 1 MHz		f = f _{MAX}							
	Min.	Typ.	Max.		Typ.[2]	Max.	Typ.[2]	Max.	Typ.[2]	Max.
M24L48512DA	2.7	3.0	3.6	55	1	5	14	22	17	40
				60						
				70						

Notes:

1. NC "no connect"—not connected internally to the die.
2. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V_{CC} = V_{CC (typ)} and T_A = 25°C.

Maximum Ratings

(Above which the useful life may be impaired. For user guide-lines, not tested.)

Storage Temperature-65°C to +150°C
 Ambient Temperature with Power Applied-40°C to +85°C
 Supply Voltage to Ground Potential-0.4V to 4.6V
 DC Voltage Applied to Outputs in High-Z State[3, 4, 5]-0.4V to 3.7V
 DC Input Voltage[3, 4, 5]-0.4V to 3.7V
 Output Current into Outputs (LOW)20 mA
 Static Discharge Voltage > 2001V (per MIL-STD-883, Method 3015)

Latch-up Current> 200 mA

Operating Range

Range	Ambient Temperature (T _A)	V _{CC}
Extended	-25°C to +85°C	2.7V to 3.6V
Industrial	-40°C to +85°C	2.7V to 3.6V

Electrical Characteristics (Over the Operating Range)

Parameter	Description	Test Conditions	-55, 60, 70			Unit
			Min.	Typ.[2]	Max.	
V _{CC}	Supply Voltage		2.7	3.0	3.6	V
V _{OH}	Output HIGH Voltage	I _{OH} = -0.1 mA	V _{CC} - 0.4			V
V _{OL}	Output LOW Voltage	I _{OL} = 0.1 mA			0.4	V
V _{IH}	Input HIGH Voltage		0.8 * V _{CC}		V _{CC} + 0.4	V
V _{IL}	Input LOW Voltage		-0.4		0.4	V
I _{IX}	Input Leakage Current	GND ≤ V _{IN} ≤ V _{CC}	-1		+1	μA
I _{OZ}	Output Leakage Current	GND ≤ V _{OUT} ≤ V _{CC} , Output Disabled	-1		+1	μA
I _{CC}	V _{CC} Operating Supply Current	f = f _{MAX} = 1/t _{RC} f = 1 MHz V _{CC} = 3.6V, I _{OUT} = 0 mA, CMOS level		14 for 55ns speed 14 for 60 ns speed 8 for 70 ns speed 1 for all speed	22 for 55 ns speed 22 for 60 ns speed 15 for 70 ns speed 5 for all speeds	mA
I _{SB1}	Automatic $\overline{CE1}$ Power-down Current —CMOS Inputs	$\overline{CE1} \geq V_{CC} - 0.2V$, $CE2 \leq 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$, $V_{IN} \leq 0.2V$, $f = f_{MAX}$ (Address and Data Only), $f = 0$		150	250	μA
I _{SB2}	Automatic $\overline{CE1}$ Power-down Current —CMOS Inputs	$\overline{CE1} \geq V_{CC} - 0.2V$, $CE2 \leq 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$, $f = 0$, $V_{CC} = 3.6V$		17	40	μA

Capacitance[6]

Parameter	Description	Test Conditions	Max.	Unit
C _{IN}	Input Capacitance	T _A = 25°C, f = 1 MHz	8	pF
C _{OUT}	Output Capacitance	V _{CC} = V _{CC(typ)}	8	pF

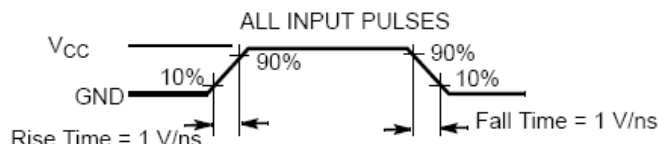
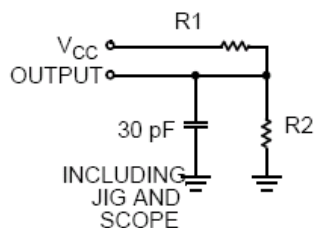
Notes:

3. V_{IH(MAX)} = V_{CC} + 0.5V for pulse durations less than 20 ns.
4. V_{IL(MIN)} = -0.5V for pulse durations less than 20 ns.
5. Overshoot and undershoot specifications are characterized and are not 100% tested.
6. Tested initially and after design or process changes that may affect these parameters.

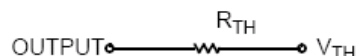
Thermal Resistance[6]

Parameter	Description	Test Conditions	VFBGA	Unit
θ_{JA}	Thermal Resistance (Junction to Ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA/JESD51.	55	°C/W
θ_{JC}	Thermal Resistance (Junction to Case)		17	°C/W

AC Test Loads and Waveforms



Equivalent to: THEVENIN EQUIVALENT



Parameters	3.0V V _{CC}	Unit
R1	22000	Ω
R2	22000	Ω
R _{TH}	11000	Ω
V _{TH}	1.50	V

Switching Characteristics (Over the Operating Range)[7]

Parameter	Description	-55		-60		-70		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle								
t _{RC}	Read Cycle Time	55 ^[11]		60		70		ns
t _{AA}	Address to Data Valid		55		60		70	ns
t _{OHA}	Data Hold from Address Change	5		8		10		ns
t _{ACE}	$\overline{CE1}$ LOW and CE2 HIGH to Data Valid		55		60		70	ns
t _{DOE}	\overline{OE} LOW to Data Valid		25		25		35	ns
t _{LZOE}	\overline{OE} LOW to Low Z[8, 9]	5		5		5		ns
t _{HZOE}	\overline{OE} HIGH to High Z[8, 9]		25		25		25	ns
t _{LZCE}	$\overline{CE1}$ LOW and CE2 HIGH to Low Z[8, 9]	2		2		5		ns
t _{HZCE}	$\overline{CE1}$ HIGH and CE2 LOW to High Z[8, 9]		25		25		25	ns
t _{SK} ^[11]	Address Skew		0		5		10	ns
Write Cycle[10]								
t _{WC}	Write Cycle Time	55		60		70		ns
t _{SCE}	$\overline{CE1}$ LOW and CE2 HIGH to Write End	45		45		60		ns
t _{AW}	Address Set-up to Write End	45		45		55		ns
t _{HA}	Address Hold from Write End	0		0		0		ns

Notes:

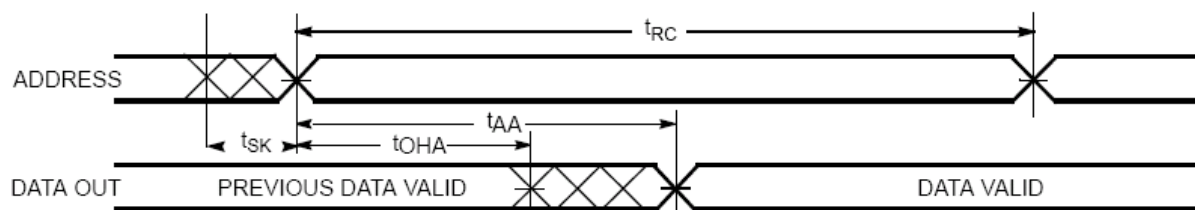
- Test conditions assume signal transition time of 1 V/ns or higher, timing reference levels of $V_{CC(typ)}/2$, input pulse levels of 0V to $V_{CC(typ)}$, and output loading of the specified I_{OL}/I_{OH} and 30-pF load capacitance.
- t_{HZOE}, t_{HZCE}, and t_{HZWE} transitions are measured when the outputs enter a high-impedance state.
- High-Z and Low-Z parameters are characterized and are not 100% tested.
- The internal write time of the memory is defined by the overlap of \overline{WE} , $\overline{CE1} = V_{IL}$, and CE2 = V_{IH}. All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input set-up and hold timing should be referenced to the edge of the signal that terminates write.
- To achieve 55-ns performance, the read access should be \overline{CE} controlled. In this case t_{ACE} is the critical parameter and t_{SK} is satisfied when the addresses are stable prior to chip enable going active. For the 70-ns cycle, the addresses must be stable within 10 ns after the start of the read cycle.

Switching Characteristics (Over the Operating Range)[7] (continued)

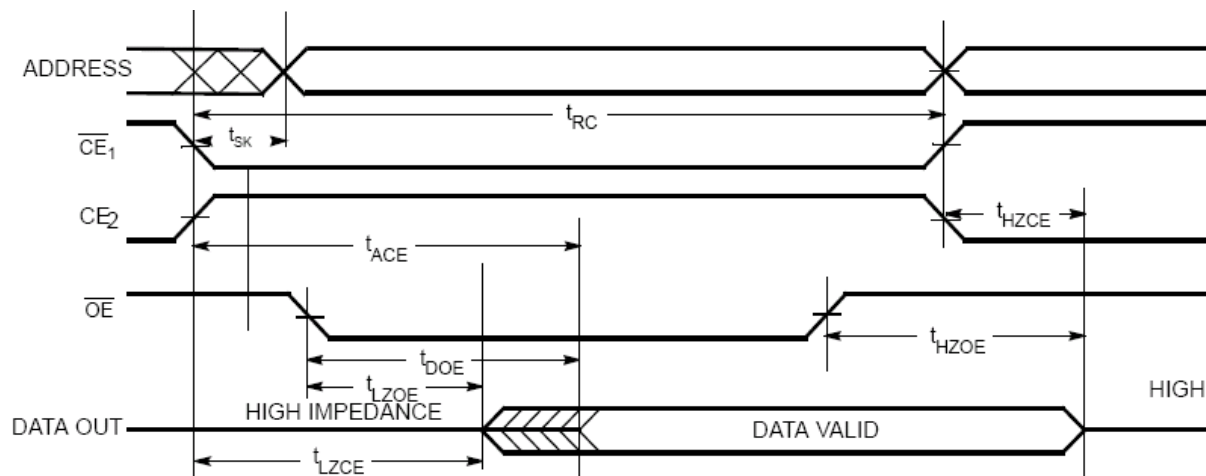
Parameter	Description	-55		-60		-70		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{SA}	Address Set-up to Write Start	0		0		0		ns
t_{PWE}	\overline{WE} Pulse Width	40		40		45		ns
t_{SD}	Data Set-up to Write End	25		25		25		ns
t_{HD}	Data Hold from Write End	0		0		0		ns
t_{HZWE}	\overline{WE} LOW to High Z[8, 9]		25		25		25	ns
t_{LZWE}	\overline{WE} HIGH to Low Z[8, 9]	5		5		5		ns

Switching Waveforms

Read Cycle 1 (Address Transition Controlled) [11, 12, 13]



Read Cycle 2 (\overline{OE} Controlled) [11, 13]



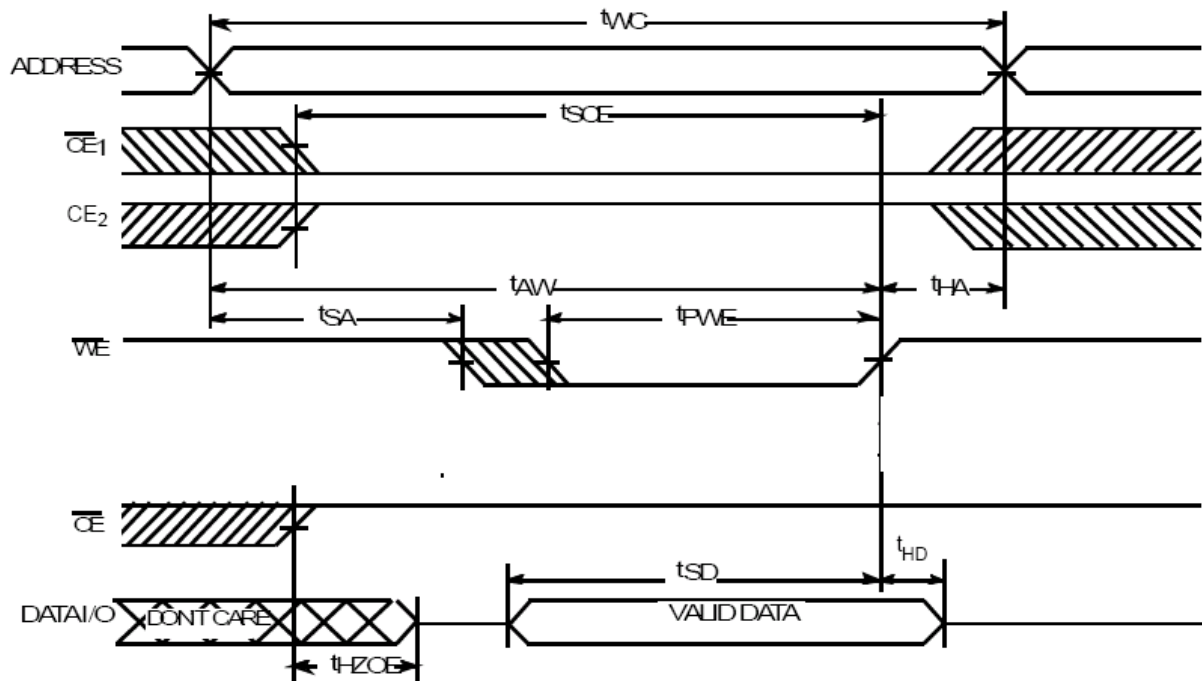
Notes:

12. Device is continuously selected. \overline{OE} , \overline{CE} = V_{IL} .

13. \overline{WE} is HIGH for Read Cycle.

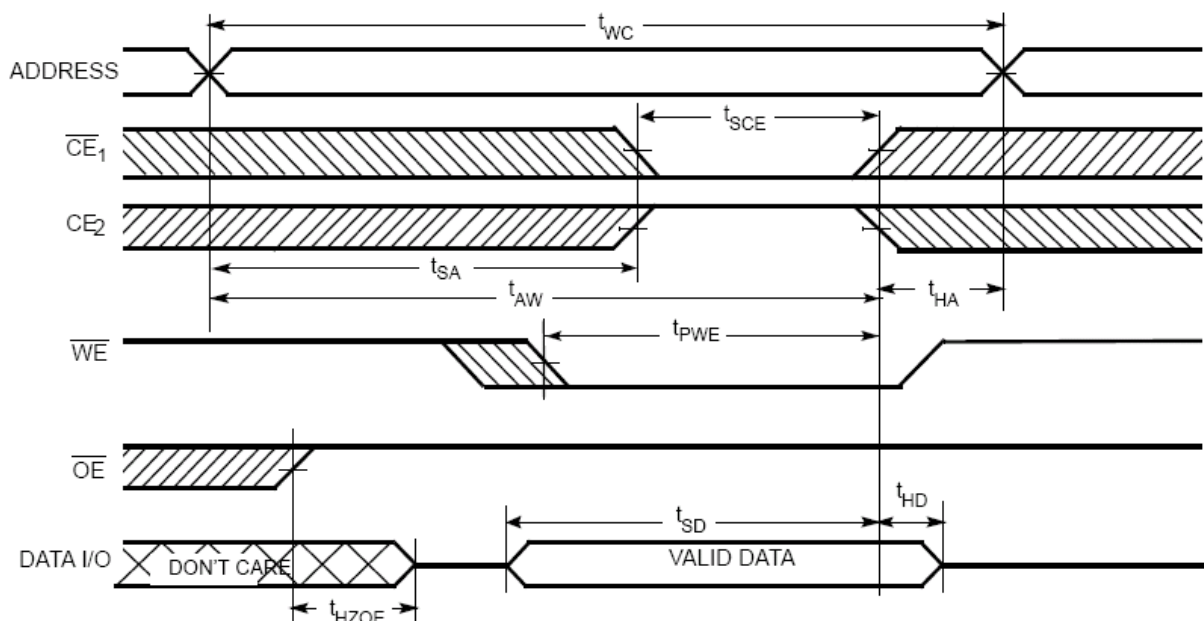
Switching Waveforms (continued)

Write Cycle No. 1 (\overline{WE} Controlled) [9, 10, 14, 15, 16]



Switching Waveforms (continued)

Write Cycle 2 ($\overline{CE1}$ or $\overline{CE2}$ Controlled) [9, 10, 14, 15, 16]



Notes:

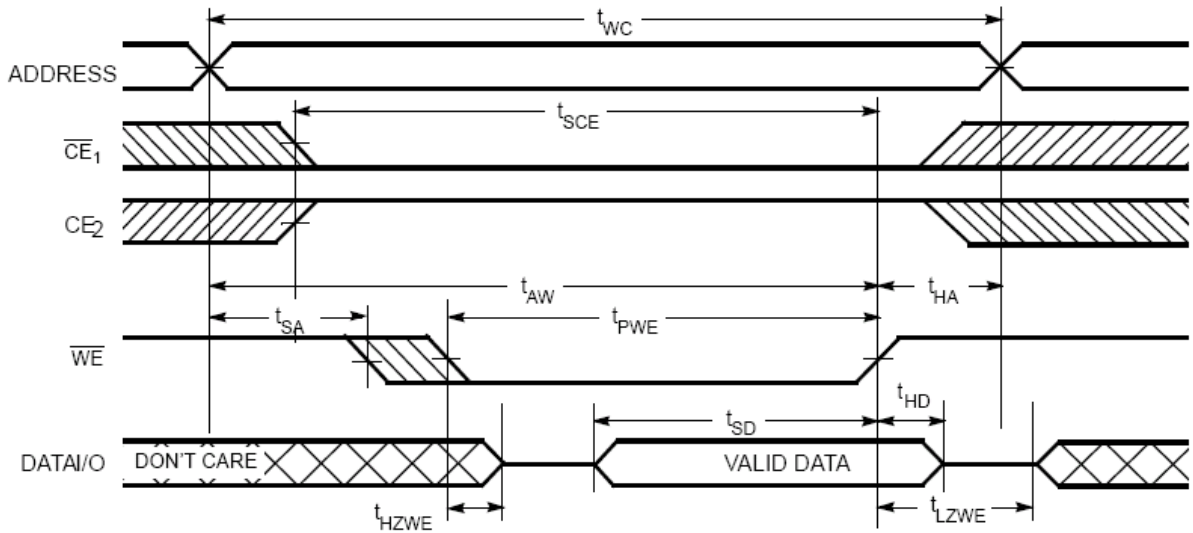
14. Data I/O is high impedance if $\overline{OE} \geq V_{IH}$.

15. If Chip Enable goes INACTIVE simultaneously with $\overline{WE} = \text{HIGH}$, the output remains in a high-impedance state.

16. During the DON'T CARE period in the DATA I/O waveform, the I/Os are in output state and input signals should not be applied.

Switching Waveforms (continued)

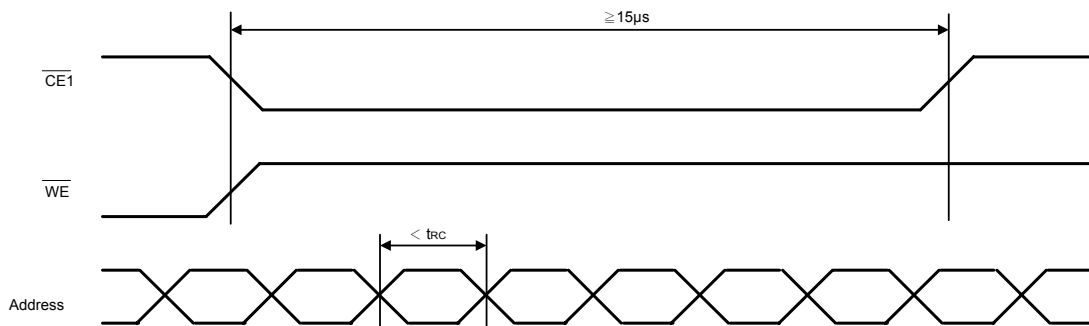
Write Cycle 3 (\overline{WE} Controlled, \overline{OE} LOW)[15, 16]



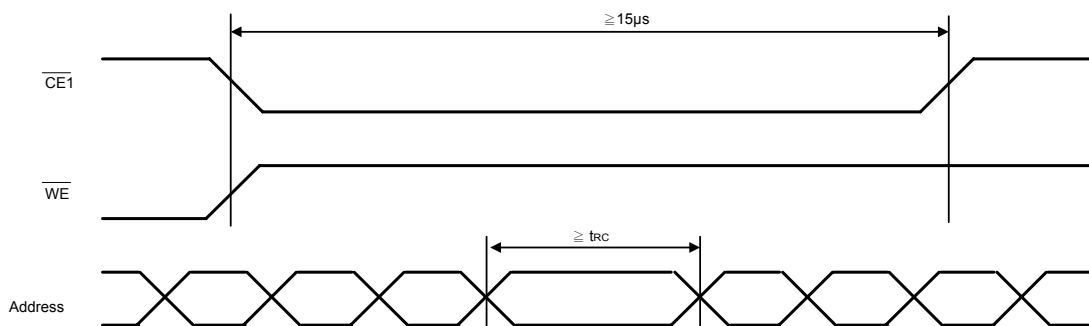
Avoid Timing

ESMT Pseudo SRAM has a timing which is not supported at read operation, If your system has multiple invalid address signal shorter than t_{RC} during over $15\mu s$ at read operation shown as in Abnormal Timing, it requires a normal read timing at least during $15\mu s$ shown as in Avoidable timing 1 or toggle $\overline{CE1}$ to high ($\geq t_{RC}$) one time at least shown as in Avoidable Timing 2.

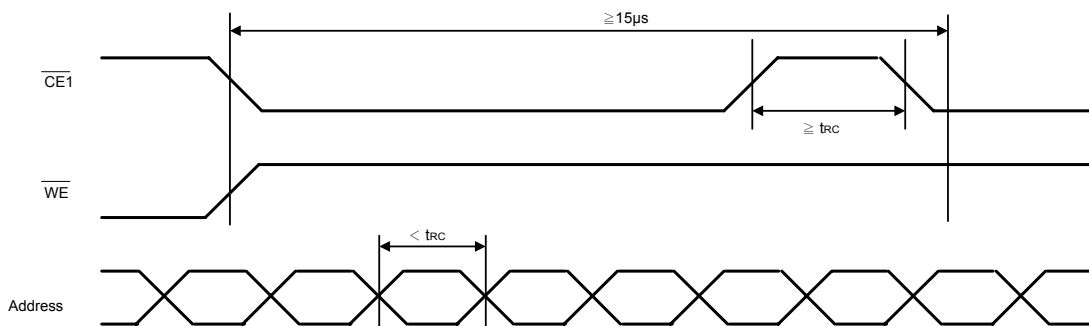
Abnormal Timing



Avoidable Timing 1



Avoidable Timing 2



Truth Table[17]

$\overline{CE1}$	$\overline{CE2}$	\overline{OE}	\overline{WE}	I/O ₀ –I/O ₇	Mode	Power
H	X	X	X	High Z	Power-down	Standby (I _{SB})
X	L	X	X	High Z	Power-down	Standby (I _{SB})
L	H	L	H	Data Out	Read	Active (I _{CC})
L	H	X	L	Data in	Write	Active (I _{CC})
L	H	H	H	High Z	Selected, Outputs Disabled	Active (I _{CC})

Ordering Information

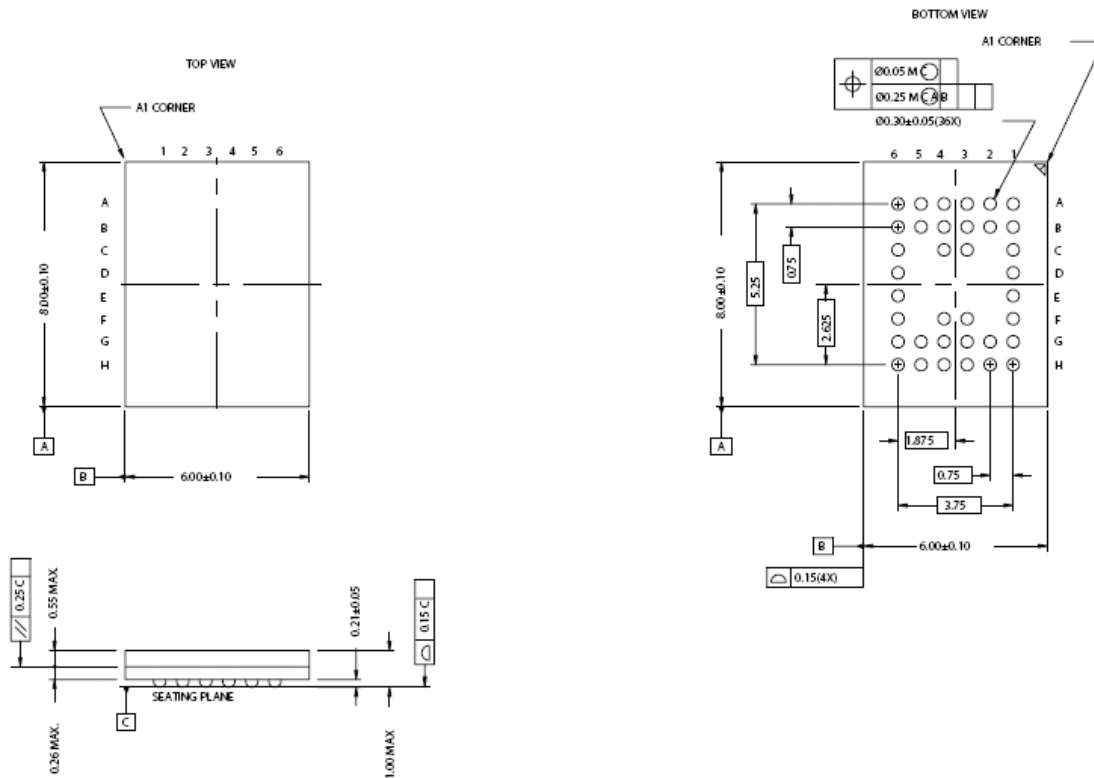
Speed (ns)	Ordering Code	Package Type	Operating Range
55	M24L48512DA-55BEG	36-Lead VFBGA (6 x 8 x 1 mm) (pb-free)	Extended
60	M24L48512DA-60BEG	36-Lead VFBGA (6 x 8 x 1 mm) (pb-free)	Extended
70	M24L48512DA-70BEG	36-Lead VFBGA (6 x 8 x 1 mm) (pb-free)	Extended
55	M24L48512DA-55BIG	36-Lead VFBGA (6 x 8 x 1 mm) (pb-free)	Industrial
60	M24L48512DA-60BIG	36-Lead VFBGA (6 x 8 x 1 mm) (pb-free)	Industrial
70	M24L48512DA-70BIG	36-Lead VFBGA (6 x 8 x 1 mm) (pb-free)	Industrial

Note:

17.H = Logic HIGH, L = Logic LOW, X = Don't Care.

Package Diagram

36-Lead VFBGA (6 x 8 x 1 mm)



Revision History

Revision	Date	Description
1.0	2007.07.19	Original
1.1	2008.07.04	1. Move Revision History to the last 2. Modify voltage range 2.7V~3.3V to 2.7V~3.6V 3. Add Industrial grade 4. Add Avoid timing

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