EPSON

SRM2AW415LLBT3

4M-bit Static RAM

Preliminary

Super Low Voltage Operation Products

- ●Super Low Voltage Operation and Low Current Consumption
- ●Access Time 85ns (2.3V)
- ●262,144 Words x 16-bit /524,288 words x 8-bit Asynchronous
- ●Wide Temperature Range

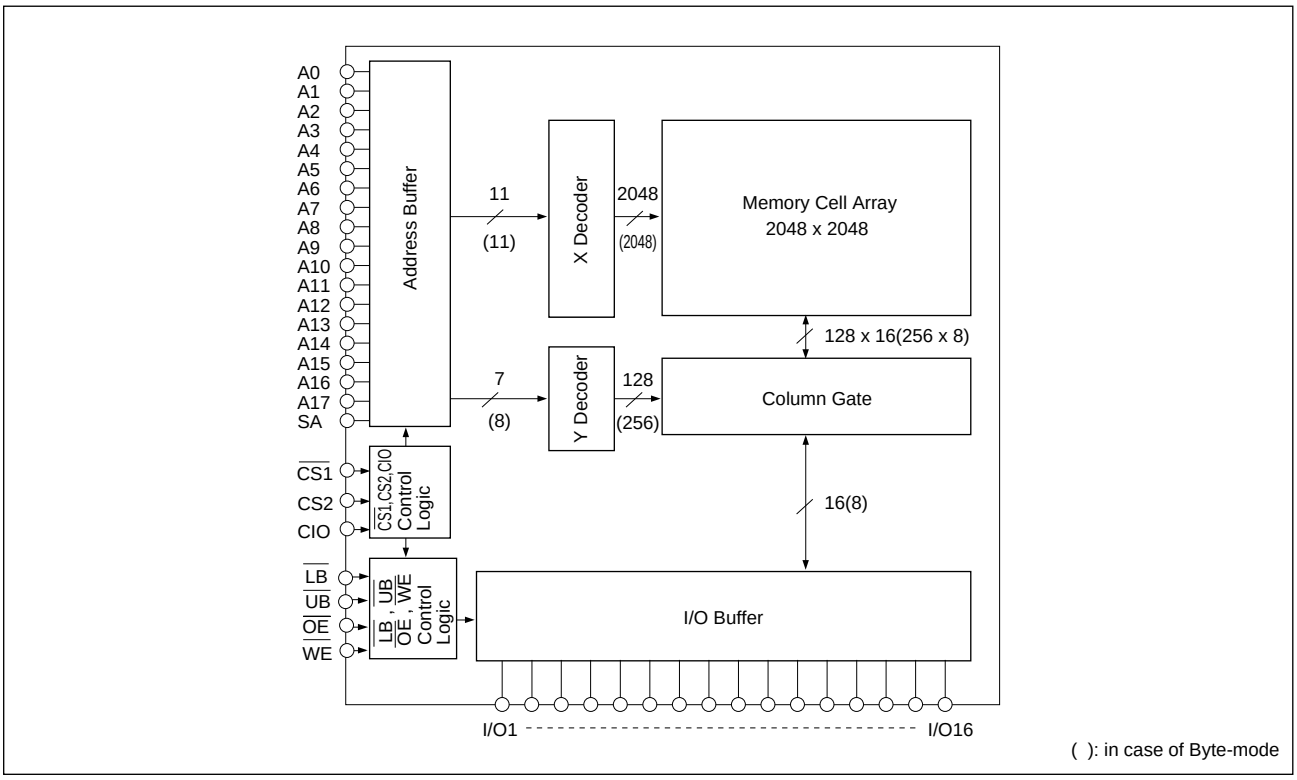
■ DESCRIPTION

The SRM2AW415LLBT3 is a 262,144 words x 16-bit (Word-mode) / 524,288 words x 8-bit (Byte-mode) asynchronous, random access memory on a monolithic CMOS chip. It is possible to select Word-mode or Byte-mode by CIO-pin: CIO=V_{DD} for Word-mode and CIO=V_{SS} for Byte-mode. Its very low standby power requirement makes it ideal for applications requiring non-volatile storage with back-up batteries. The asynchronous and static nature of the memory requires no external clock and no refreshing circuit. It is possible to control the data width by the data byte control for Word-mode. 3-state output allows easy expansion of memory capacity. The temperature range of the SRM2AW415LLBT3 is from –40 to 85°C, and it is suitable for the industrial products.

■ FEATURES

- ● Fast Access time 85ns (2.3V)
- ● Low supply current ..... LL Version
- ● Completely static ..... No clock required
- ● Supply voltage ..... 2.3V to 3.0V
- ● 3-state output with wired-OR capability
- ● Non-volatile storage with back-up batteries
- ● Package ..... SRM2AW415LLBT TFBGA-48 pin (Tape CSP)

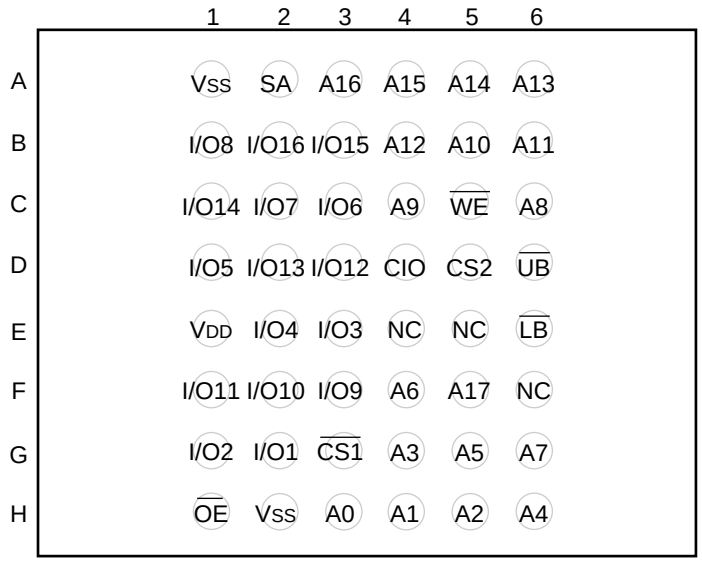
■ BLOCK DIAGRAM



■ PIN CONFIGURATION

TFBGA-48 pin

SRM2AW415LLBT



Top view (Looking through part)

■ PIN DESCRIPTION

A0 to A17	Address Input
SA	Address Input (Byte-mode use)
$\overline{WE}$	Write Enable
$\overline{OE}$	Output Enable
$\overline{CS1}$	Chip Select1
CS2	Chip Select2
$\overline{LB}$	LOWER Byte Enable (Word-mode use)
$\overline{UB}$	UPPER Byte Enable (Word-mode use)
I/O1 to 16	Data I/O
CIO	Word-mode/Byte-mode Selection
V_{DD}	Power Supply (2.3V to 3.0V)
V_{SS}	Power Supply (0V)
NC	No connection

■ ABSOLUTE MAXIMUM RATINGS

(V_{SS}=0V)

Parameter	Symbol	Ratings	Unit
Supply voltage	V_{DD}	– 0.5 to 3.6	V
Input voltage	V_I	– 0.5 * to V_{DD} + 0.3	V
Input/Output voltage	$V_{I/O}$	– 0.5 * to V_{DD} + 0.3	V
Power dissipation	P_D	0.5	W
Operating temperature	T_{opr}	– 40 to 85	°C
Storage temperature	T_{stg}	– 65 to 150	°C
Soldering temperature and time	T_{sol}	260°C, 10s (at lead)	–

* V_I,$V_{I/O}$ (Min.) = –2.0V (when pulse width is less than 50ns)

■ DC RECOMMENDED OPERATING CONDITIONS

(Ta = –40 to 85 °C)

Parameter	Symbol	V_{DD} = 2.3 to 3.0V			Unit
		Min.	Typ.	Max.	
Supply voltage	V_{DD}	2.3	2.5	3.0	V
	V_{SS}	0.0	0.0	0.0	V
Input voltege	V_{IH}	0.75V_{DD}	–	V_{DD}+0.3	V
	V_{IL}	– 0.3*	–	0.3	V

* if pulse width is less than 50ns it is – 2.0V

■ ELECTRICAL CHARACTERISTICS

● DC Electrical Characteristics

(V_{SS} =0V, Ta = –40 to 85 °C)

Parameter	Symbol	Conditions		V_{DD} = 2.3 to 3.0V			Unit
				Min.	Typ. *1	Max.	
Input leakage current	I_{LI}	V_I = 0 to V_{DD}		–1.0	–	1.0	µA
Output leakage current	I_{LO}	$\overline{LB}$ and $\overline{UB}$ = V_{IH} or $\overline{CS1}$ = V_{IH} or CS2 = V_{IL} or $\overline{WE}$=V_{IL} or $\overline{OE}$ = V_{IH}, $V_{I/O}$ = 0 to V_{DD}		–1.0	–	1.0	µA
High level output voltage	V_{OH}	I_{OH}	–0.5mA	1.8	–	–	V
			–100µA	V_{DD}–0.2	–	–	
Low level output voltage	V_{OL}	I_{OL}	1.0mA	–	–	0.4	V
			100µA	–	–	0.2	
Standby supply current	I_{DDS}	$\overline{CS1}$ = V_{IH} or CS2= V_{IL}		–	–	1.0	mA
	I_{DDS1}	$\overline{CS1}$ = CS2 ≥ V_{DD} – 0.2V or CS2 ≤ 0.2V		–	0.4	10	µA
Average operating current	I_{DDA}	V_I = V_{IL} or V_{IH}, $I_{I/O}$ = 0mA, t_{cyc} = Min.		–	25	35	mA
	I_{DDA2}	V_I = V_{IL} or V_{IH}, $I_{I/O}$ = 0mA, t_{cyc} = 200ns		–	12	18	mA
	I_{DDA1}	V_I = V_{IL} or V_{IH}, $I_{I/O}$ = 0mA, t_{cyc} = 1µs		–	3.0	5.0	mA
Operating Supply Current	I_{DDO}	V_I = V_{IL} or V_{IH}, $I_{I/O}$ = 0mA		–	3.0	5.0	mA

*1 : Typical values are measured at Ta = 25°C and V_{DD} = 2.5V

● Terminal Capacitance

(Ta = 25°C, f = 1MHz)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Address Capacitance	C_{ADD}	V_{ADD} = 0V	–	–	8	pF
Input Capacitance	C_I	V_I = 0V	–	–	8	pF
I/O Capacitance	$C_{I/O}$	$V_{I/O}$ = 0V	–	–	10	pF

Note : This parameter is made by the inspection data of sample, not of all products

● AC Electrical Characteristics

❍ Read Cycle

(V_{SS} = 0V, Ta = –40 to 85°C)

Parameter	Symbol	Test Conditions	SRM2AW415LLBT3		Unit
			2.3 to 3.0V		
			Min.	Max.	
Read cycle time	t_{RC}	1	85	–	ns
Address access time	t_{ACC}	1	–	85	ns
$\overline{CS1}$ access time	t_{ACS1}	1	–	85	ns
CS2 access time	t_{ACS2}	1	–	85	ns
$\overline{OE}$ access time	t_{OE}	1	–	45	ns
$\overline{LB}$, $\overline{UB}$ access time ※	t_{AB}	1	–	45	ns
$\overline{CS1}$ output set time	t_{CLZ1}	2	5	–	ns
CS2 output set time	t_{CLZ2}	2		–	ns
$\overline{CS1}$ output floating	t_{CHZ1}	2	–	30	ns
CS2 output floating	t_{CHZ2}	2	–	30	ns
$\overline{LB}$, $\overline{UB}$ output set time ※	t_{BLZ}	2	0	–	ns
$\overline{LB}$, $\overline{UB}$ output floating ※	t_{BHZ}	2	–	30	ns
$\overline{OE}$ output set time	t_{OLZ}	2	0	–	ns
$\overline{OE}$ output floating	t_{OHZ}	2	–	30	ns
Output hold time	t_{OH}	1	5	–	ns

※ Word-mode only

❍ Write Cycle

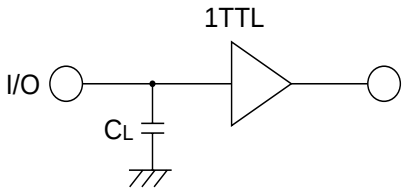
(V_{SS} = 0V, Ta = –40 to 85°C)

Parameter	Symbol	Test Conditions	SRM2AW415LLBT3		Unit
			2.3 to 3.0V		
			Min.	Max.	
Write cycle time	t_{WC}	1	85	–	ns
Chip select time ($\overline{CS1}$)	t_{CW1}	1	70	–	ns
Chip select time (CS2)	t_{CW2}	1	70	–	ns
Address enable time	t_{AW}	1	70	–	ns
Address setup time	t_{AS}	1	0	–	ns
Write pulse width	t_{WP}	1	65	–	ns
$\overline{LB}$, $\overline{UB}$ select time※	t_{BW}	1	70	–	ns
Address hold time	t_{WR}	1	0	–	ns
Data setup time	t_{DW}	1	45	–	ns
Data hold time	t_{DH}	1	0	–	ns
$\overline{WE}$ output floating	t_{WHZ}	2	–	35	ns
$\overline{WE}$ output set time	t_{OW}	2	5	–	ns

※ Word-mode only

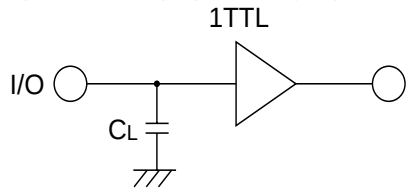
*1 Test Conditions

1. Input pulse level : 0.3V to 0.8V_{DD}(2.3Vto 3.0V)
2. $t_r = t_f$ = 5ns
3. Input and output timing reference levels :1/2V_{DD}(2.3V to 3.0V)
4. Output load : C_L =50pF (Includes Jig Capacitance)



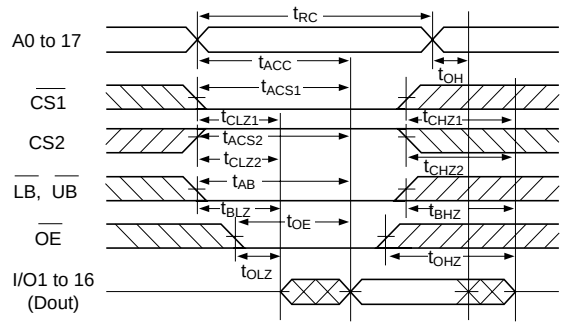
*2 Test Conditions

1. Input pulse level : 0.3V to 0.8V_{DD}(2.3V to 3.0V)
2. $t_r = t_f$ = 5ns
3. Input timing reference levels :1/2V_{DD}(2.3V to 3.0V)
4. Output timing reference levels : ±200mV (The level changed from stable output voltage level)
5. Output load :C_L = 5pF (Includes Jig Capacitance)

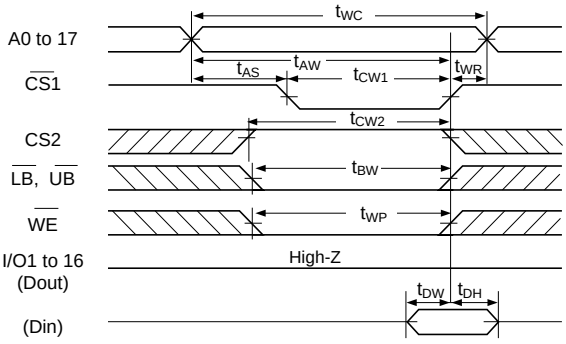


● Timing Chart (Word-mode)

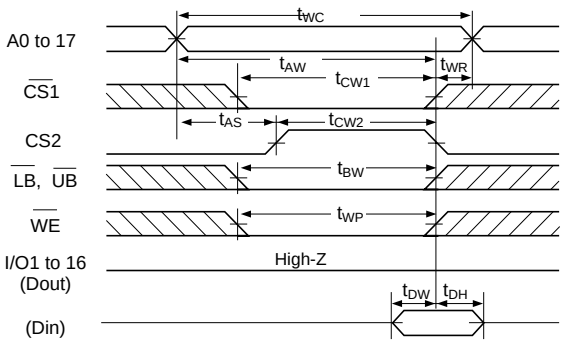
Read Cycle*1



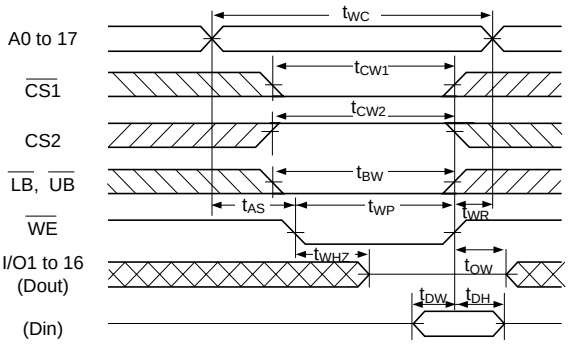
Write Cycle 1 (CS1 Control) *2, *3



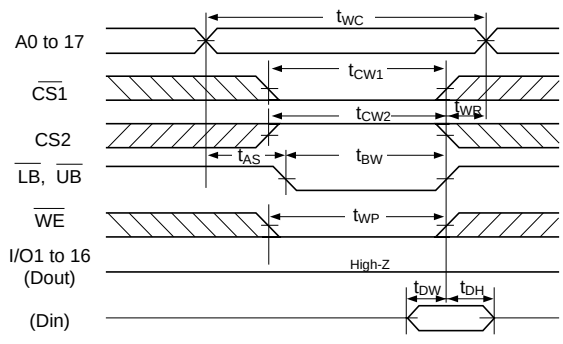
Write Cycle 2 (CS2 Control) *2, *3



Write Cycle 3 (WE Control)*3



Write Cycle 4 (UB, LB Control) *3

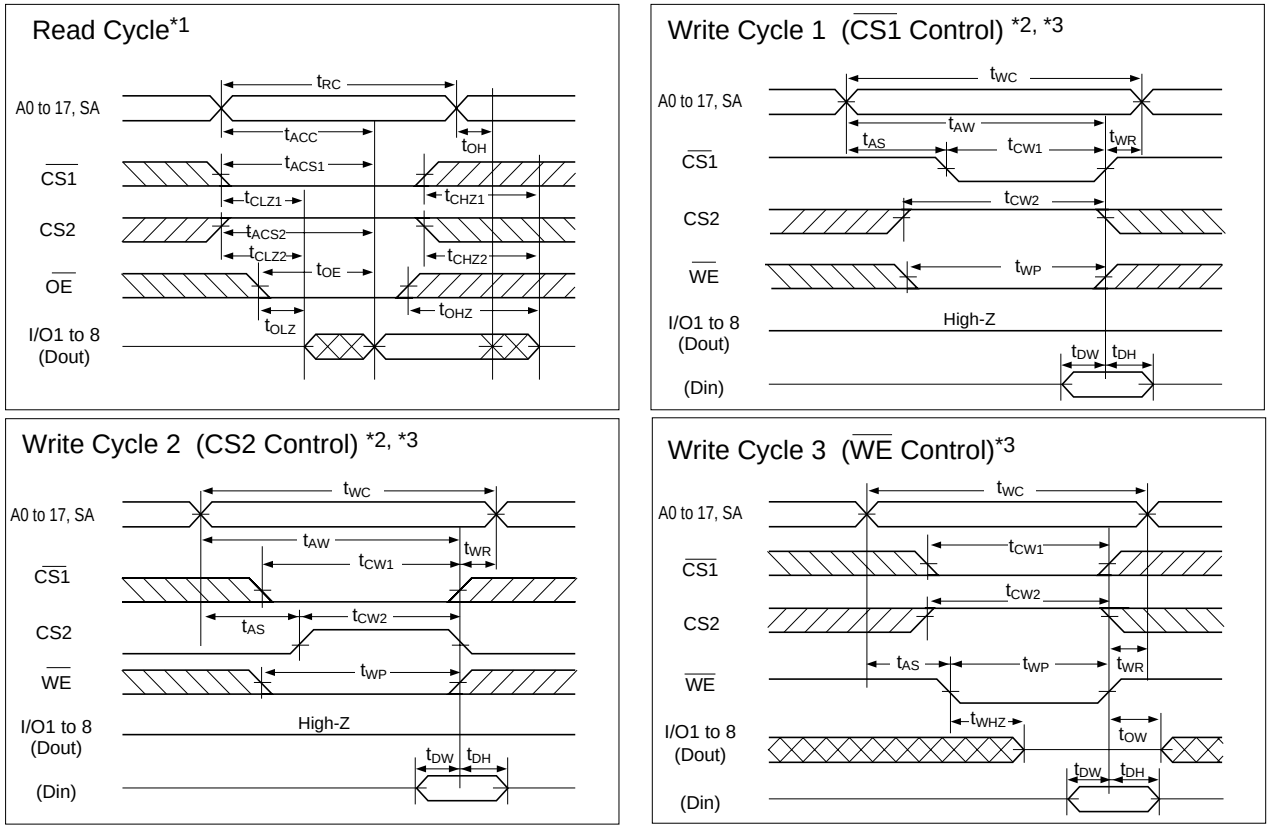


Note : *1 During read cycle time, WE is to be "High" level.

*2 In write cycle time that is controlled by CS1 or CS2, output buffer is to be "Hi-Z" state even if OE is "Low" level.

*3 When output buffer is in output state, be careful that do not input the opposite signals to the output data.

● Timing Chart (Byte-mode)



Note : *1 During read cycle time, $\overline{WE}$ is to be "High" level.
*2 In write cycle time that is controlled by $\overline{CS1}$ or CS2, output buffer is to be "Hi-Z" state even if $\overline{OE}$ is "Low" level.
*3 When output buffer is in output state, be careful that do not input the opposite signals to the output data.

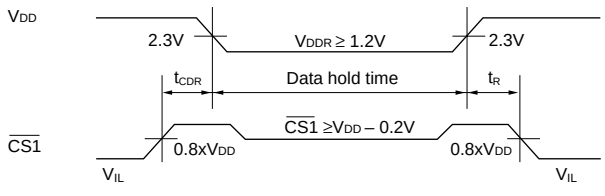
● DATA RETENTION CHARACTERISTIC WITH LOW VOLTAGE POWER SUPPLY

(V_{SS} = 0V, Ta = –40 to 85°C)

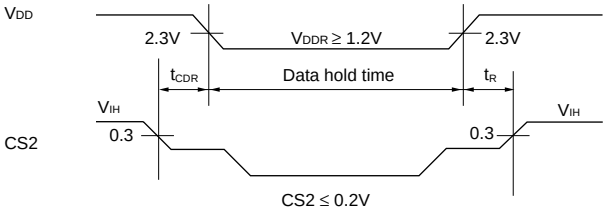
Parameter	Symbol	Conditions	Min.	Typ.*	Max.	Unit
Data retention supply voltage	V_{DDR}		1.2	–	3.0	V
Data retention curren	I_{DDR}	V_{DDR} = 2.5V $\overline{CS1}$ = CS2≥ V_{DD} – 0.2V or CS2 ≤0.2V	–	0.4	8.5	µA
Data hold time	t_{CDR}		0	–	–	ns
Operation recovery time	t_R		5	–	–	ms

* : Reference data at Ta=25°C

Data retention timing ($\overline{CS1}$ Control)



Data retention timing (CS2 Control)



■ FUNCTIONS

● Truth Table

<Word-mode>

CIO	$\overline{CS1}$	CS2	$\overline{OE}$	$\overline{WE}$	SA	$\overline{LB}$	$\overline{UB}$	I/O1 to 8	I/O9 to 16	MODE	I_{DD}
H	H	X	X	X	X	X	X	High-Z	High-Z	Not Selected	I_{DDS}, I_{DDS1}
H	X	L	X	X	X	X	X	High-Z	High-Z	Not Selected	I_{DDS}, I_{DDS1}
H	L	H	X	X	X	H	H	High-Z	High-Z	Output disable	I_{DDA}, I_{DDA1}, I_{DDA2}
H	L	H	H	H	X	X	X	High-Z	High-Z	Output disable	I_{DDA}, I_{DDA1}, I_{DDA2}
H	L	H	L	H	X	L	L	Data Out	DataOut	Word Read	I_{DDA}, I_{DDA1}, I_{DDA2}
H	L	H	L	H	X	L	H	Data Out	High-Z	Lower Byte Read	I_{DDA}, I_{DDA1}, I_{DDA2}
H	L	H	L	H	X	H	L	High-Z	DataOut	Upper Byte Read	I_{DDA}, I_{DDA1}, I_{DDA2}
H	L	H	X	L	X	L	L	Data In	Data In	Word write	I_{DDA}, I_{DDA1}, I_{DDA2}
H	L	H	X	L	X	L	H	Data In	High-Z	Lower Byte write	I_{DDA}, I_{DDA1}, I_{DDA2}
H	L	H	X	L	X	H	L	High-Z	Data In	Upper Byte write	I_{DDA}, I_{DDA1}, I_{DDA2}

X : High or Low

<Byte-mode>

CIO	$\overline{CS1}$	CS2	$\overline{OE}$	$\overline{WE}$	SA	$\overline{LB}$	$\overline{UB}$	I/O1 to 8	I/O9 to 16	MODE	I_{DD}
L	H	X	X	X	X	X	X	High-Z	High-Z	Not Selected	I_{DDS}, I_{DDS1}
L	X	L	X	X	X	X	X	High-Z	High-Z	Not Selected	I_{DDS}, I_{DDS1}
L	L	H	H	H	SA	X	X	High-Z	High-Z	Output disable	I_{DDA}, I_{DDA1}, I_{DDA2}
L	L	H	L	H	SA	X	X	Data Out	High-Z	Byte Read	I_{DDA}, I_{DDA1}, I_{DDA2}
L	L	H	X	L	SA	X	X	Data In	High-Z	Byte Write	I_{DDA}, I_{DDA1}, I_{DDA2}

X : High or Low
SA: available as address

● Selection of Word-mode or Byte-mode

It is possible to select Word-mode (262,144 words X 16-bit) or Byte-mode (524,288 words x 8-bit) by CIO-pin: CIO=V_{DD} for Word-mode and CIO=V_{SS} for Byte-mode.

During Reading data, Writing date, Standby mode, or Data retention, do not change the voltage on CIO.

(1) Word-mode (262,144 words x 16-bit)

In case of Word-mode, SA-pin is invalid and "High" or "Low" can be applied.

It is possible to control the data width by $\overline{UB}$ and $\overline{LB}$ pins.

(2) Byte-mode (524,288 words x 8-bit)

In case of Byte-mode, SA-pin can be used as an address pin.

$\overline{UB}$ and $\overline{LB}$ pins are invalid and "High" or "Low" can be applied.

And I/O 9 to 16 are in "High-Z" states.

● Reading data

● Word-mode

It is possible to control the data width by $\overline{LB}$ and $\overline{UB}$ pins.

(1) Reading data from lower byte

Data is able to be read when the address is set while holding $\overline{CS1}$ ="Low",CS2 = "High", $\overline{OE}$= "Low", $\overline{LB}$ ="Low", and $\overline{WE}$ = "High".

(2) Reading data from upper byte

Data is able to be read when the address is set while holding $\overline{CS1}$= "Low",CS2 = "High", $\overline{OE}$ = "Low", $\overline{UB}$ = "Low", and $\overline{WE}$ ="High".

(3) Reading data from both bytes

Data is able to be read when the address is set while holding $\overline{CS1}$ = "Low",CS2= "High", $\overline{OE}$ ="Low", $\overline{UB}$ ="Low", $\overline{LB}$ = "Low", and $\overline{WE}$ = "High".

● Byte-mode

(1) Reading data from byte

Data is able to read when address and SA are set while holding $\overline{CS1}$ ="Low", CS2 = "High", $\overline{OE}$= "Low", and $\overline{WE}$ = "High".

Since I/O pins are in "Hi-Z" state when $\overline{OE}$ = "High", the data bus line can be used for any other objective, then access time is apparently able to be cut down.

● Writing data

● Word-mode

(1) Writing data into lower byte

There are the following four ways of writing data into memory.

i) Hold CS2 = "High",$\overline{WE}$ = "Low",$\overline{UB}$ ="High", and $\overline{LB}$ = "Low",set address and give "Low" pulse to $\overline{CS1}$.
ii) Hold $\overline{CS1}$ = "Low",$\overline{WE}$ = "Low",$\overline{UB}$ ="High", and $\overline{LB}$ = "Low",set address and give "High" pulse to CS2.
iii) Hold $\overline{CS1}$ = "Low",CS2 = "High",$\overline{UB}$ ="High", and $\overline{LB}$ = "Low",set address and give "Low" pulse to $\overline{WE}$
ix) Hold $\overline{CS1}$ = "Low",CS2 = "High",$\overline{WE}$ ="Low",and $\overline{UB}$= "High",set address and give "Low" pulse to $\overline{LB}$.

Anyway, data on I/O pins are latched up into the memory cell during $\overline{CS1}$ ="Low",CS2 = "High",$\overline{WE}$ and $\overline{LB}$ ="Low".

(2) Writing data into upper byte

There are the following four ways of writing data into the memory.

i) Hold CS2 ="High",$\overline{WE}$ ="Low",$\overline{LB}$ ="High",and $\overline{UB}$ ="Low",set address and give "Low" pulse to $\overline{CS1}$.
ii) Hold $\overline{CS1}$ ="Low",$\overline{WE}$ ="Low",$\overline{LB}$ ="High",and $\overline{UB}$ ="Low",set address and give "High" pulse to CS2.
iii) Hold $\overline{CS1}$ ="Low",CS2 ="High",$\overline{LB}$ ="High",and $\overline{UB}$ ="Low",set address and give "Low" pulse to $\overline{WE}$.
ix) Hold $\overline{CS1}$="Low",CS2 ="High",$\overline{WE}$="Low",and $\overline{LB}$="High",set address and give "Low" pulse to $\overline{UB}$.

Anyway, data on I/O pins are latched up into the memory cell during $\overline{CS1}$ ="Low",CS2 = "High",$\overline{WE}$ and $\overline{UB}$ ="Low".

(3)Writing data into both bytes

There are the following four ways of writing data into the memory.

i) Hold CS2 = "High", $\overline{WE}$ = "Low", $\overline{LB}$ and $\overline{UB}$ = "Low", set address and give "Low" pulse to $\overline{CS1}$.
ii) Hold $\overline{CS1}$ = "Low", $\overline{WE}$ = "Low", $\overline{LB}$ and $\overline{UB}$ = "Low", set address and give "High" pulse to CS2.
iii) Hold $\overline{CS1}$ = "Low", CS2 = "High", $\overline{LB}$ and $\overline{UB}$ = "Low", set address and give "Low" pulse to $\overline{WE}$.
ix) Hold $\overline{CS1}$ = "Low", CS2 = "High", $\overline{WE}$ = "Low", set address and give "Low" pulse to $\overline{LB}$ and $\overline{UB}$.

Anyway, data on I/Opins are latched up into the memory cell during $\overline{CS1}$ = "Low" , CS2 ="High" , $\overline{WE}$ = "Low", $\overline{UB}$ and $\overline{LB}$ = "Low".

● Byte-mode

(1) Writing data into byte

There are the following three ways of writing data into the memory.

i) Hold CS2 = "High",$\overline{WE}$ = "Low",set address and SA, then give "Low" pulse to $\overline{CS1}$.
ii) Hold $\overline{CS1}$ = "Low",$\overline{WE}$ = "Low",set address and SA, then give "High" pulse to CS2.
iii) Hold $\overline{CS1}$ = "Low",$\overline{CS2}$ = "High"set address and SA, then give "Low" pulse to $\overline{WE}$

Anyway, data on I/O pins are latched up into the memory cell during $\overline{CS1}$ ="Low",CS2 = "High", and $\overline{WE}$ ="Low".

As DATA I/O pins are in "Hi-Z" when $\overline{CS1}$= "High", CS2 = "Low", $\overline{OE}$= "High", or $\overline{LB}$ and $\overline{UB}$="High"(Word-mode), the contention on the data bus can be avoided. But while I/O pins are in the output state, the data that is opposite to the output data should not be given.

● Standby mode

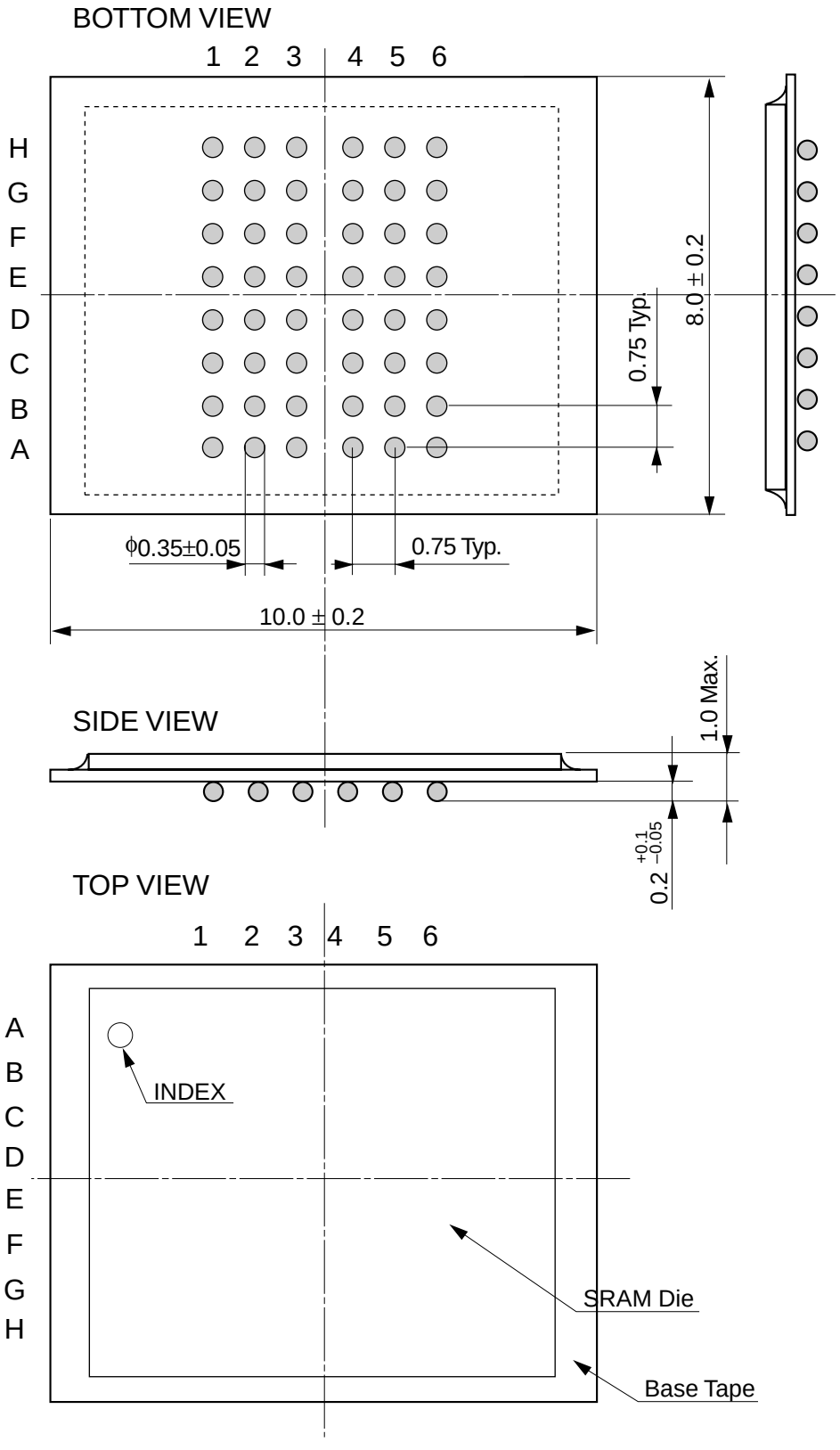
When $\overline{CS1}$ is "High" or CS2 is "Low" the chip is in the standby mode (only retaining data operation). In this case data I/O pins are Hi-Z, and all inputs of addresses, $\overline{WE}$, $\overline{OE}$, $\overline{UB}$, $\overline{LB}$, and data are inhibited. When $\overline{CS1}$ = CS2 ≥ V_{DD} - 0.2V or CS2 ≤ 0.2V, there is almost no current flow except through the high resistance parts of the memory.

● Data retention at low voltage

In case of the data retention in the stadby mode, the power supply can be gone down till the specified voltage. But it is impossible to write or read in this mode.

■ PACKAGE DIMENSIONS

TFBGA-48 pin



Unit : mm

■ CHARACTERISTICS CURVES

Under Measurement

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■ EPSON Electronic Devices Website

http://www.epson.co.jp/device/

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