

PRELIMINARY
 Note : This is not a final specification
 Some parametric limits are subject to change

MITSUBISHI LSIs

**M5M51R16AWG -10LI, -12LI, -15LI,
 -10HI, -12HI, -15HI**
 1048576-BIT(65536-WORD BY 16-BIT)CMOS STATIC RAM

DESCRIPTION

The M5M51R16AWG is a 1048576-bit CMOS static RAM organized as 65536 words by 16-bits, which are fabricated using high-performance CMOS technology. The use of CMOS cells and periphery results in a high density and low power static RAM.

The M5M51R16AWG can achieve low stand-by current and low operation current and ideal for the battery back-up application.

The M5M51R16AWG is packaged in a 48-pin chip scale package which is a high reliability and high density surface mount device (SMD). Using this type of devices, it becomes very easy to design a small system.

The M5M51R16AWG is fully compatible with the M5M51R16WG.

FEATURE

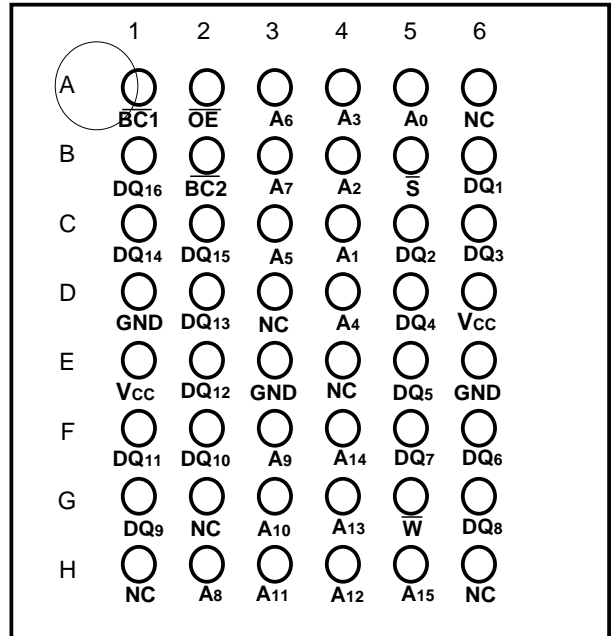
Type name	Access time (max)	Power supply current	
		Active (max)	Stand-by (max)
M5M51R16AWG- 10LI M5M51R16AWG- 12LI M5M51R16AWG- 15LI	100ns 120ns 150ns	10mA (1MHz)	4μA
M5M51R16AWG- 10HI M5M51R16AWG- 12HI M5M51R16AWG- 15HI	100ns 120ns 150ns		2μA

- Single +1.8V~2.7V power supply
- Low power down current 0.05μA(typ.)
- Directly TTL compatible : All inputs and outputs
- Easy memory expansion and power down by \overline{S} , $\overline{BC1}$ and $\overline{BC2}$
- Data hold on +1.0V power supply
- Three-state outputs : OR-tie capability
- \overline{OE} prevents data contention in the I/O bus
- Common data I/O
- Separate control of lower and upper bytes by $\overline{BC1}$ and $\overline{BC2}$
- Package
 - 48-pin chip scale package(CSP)
 - Ball pitch : 0.75mm
 - Package size: 7.0mm x 8.5mm

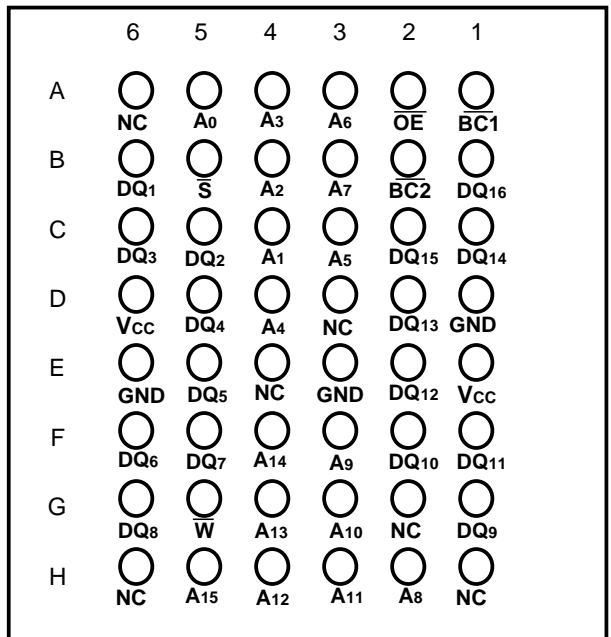
APPLICATION

Small capacity memory units.

PIN CONFIGURATION (TOP VIEW)



PIN CONFIGURATION (BOTTOM VIEW)



Outline 48FJA

NC : NO CONNECTION

FUNCTION

The operation mode of the M5M51R16A series are determined by a combination of the device control inputs \bar{S} , \bar{W} , \bar{OE} , $\bar{BC1}$ and $\bar{BC2}$. Each mode is summarized in the function table.

A write cycle is executed whenever the low level \bar{W} overlaps with the low level $\bar{BC1}$ and/or $\bar{BC2}$ and the low level \bar{S} . The address must be set up before the write cycle and must be stable during the entire cycle. The data is latched into a cell on the trailing edge of \bar{W} , $\bar{BC1}$, $\bar{BC2}$ or \bar{S} , whichever occurs first, requiring the set-up and hold time relative to these edge to be maintained. The output enable input \bar{OE} directly controls the output stage. Setting the \bar{OE} at a high level, the output stage is in a high-impedance state, and the data bus contention problem in the write cycle is eliminated.

A read cycle is executed by setting \bar{W} at a high level and \bar{OE} at a low level while $\bar{BC1}$ and/or $\bar{BC2}$ and \bar{S} are in an active state. ($\bar{BC1}$ and/or $\bar{BC2}=L$, $\bar{S}=L$)

When setting $\bar{BC1}$ at a high level and the other pins are in an active state, upper-Byte are in a selectable mode in which both reading and writing are enabled, and lower -Byte are in a non-selectable mode. And when setting $\bar{BC2}$ at a high level and the other pins are in an active state, lower-Byte are in a selectable mode in which both reading and writing are enabled, and upper -Byte are in a non-selectable mode.

When setting $\bar{BC1}$ and $\bar{BC2}$ at a high level or \bar{S} at a high level, the chips are in a non-selectable mode in which both reading and writing are disabled.

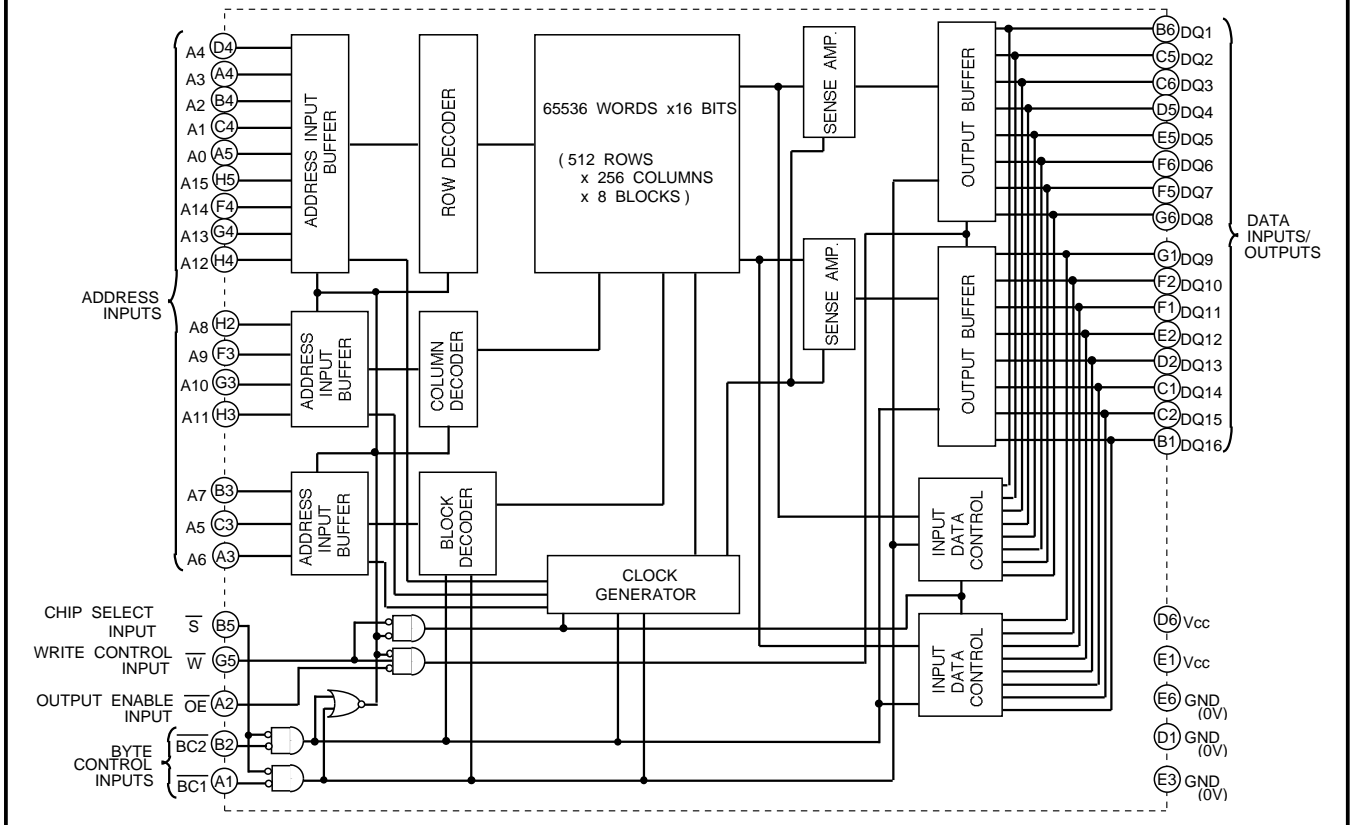
In this mode, the output stage is in a high-impedance state, allowing \bar{OR} -tie with other chips and memory expansion by $\bar{BC1}$, $\bar{BC2}$ and \bar{S} . \bar{S} , $\bar{BC1}$ and $\bar{BC2}$ control the power down feature. When \bar{S} , $\bar{BC1}$ and $\bar{BC2}$ go high, the power supply current is reduced as low as the stand-by current which is specified as I_{cc3} or I_{cc4} , and the memory data can be held at +1.0V power supply, enabling battery back-up operation during power-failure or power-down operation in the non-selected mode.

FUNCTION TABLE

\bar{S}	\bar{W}	\bar{OE}	$\bar{BC1}$	$\bar{BC2}$	Mode	DQ1~8	DQ9~16	Icc
L	H	L	L	L	Word Read	Dout	Dout	Active
L	H	L	H	L	Upper-Byte Read (Lower-Byte Non selection)	High-Z	Dout	Active
L	H	L	L	H	Lower-Byte Read (Upper-Byte Non selection)	Dout	High-Z	Active
L	L	X	L	L	Word Write	Din	Din	Active
L	L	X	H	L	Upper-Byte Write (Lower-Byte Non selection)	High-Z	Din	Active
L	L	X	L	H	Lower-Byte Write (Upper-Byte Non selection)	Din	High-Z	Active
L	H	H	X	X	Output disable	High-Z	High-Z	Active
X	X	X	H	H	Non selection	High-Z	High-Z	Stand-by
H	X	X	X	X	Non selection	High-Z	High-Z	Stand-by

(High-Z=High-impedance)

BLOCK DIAGRAM



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ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
V _{cc}	Supply voltage	With respect to GND	-0.2 ~ 4.6	V
V _i	Input voltage		-0.2* ~ V _{cc} +0.2(max.4.6V)	V
V _o	Output voltage		0 ~ V _{cc}	V
P _d	Power dissipation	T _a =25°C	1	W
T _{opr}	Operating temperature		-40 ~ 85	°C
T _{stg}	Storage temperature		-65 ~ 150	°C

* -1.0V in case of AC (Pulse width 30ns)

DC ELECTRICAL CHARACTERISTICS (T_a = - 40~85°C, V_{cc} = 1.8V~2.7V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V _{IH}	High-level input voltage		0.7 x V _{cc}		V _{cc} +0.2V	V
V _{IL}	Low-level input voltage		-0.2*		0.4	V
V _{OH}	High-level output voltage	I _{OH} = -0.1mA	1.6			V
V _{OL}	Low-level output voltage	I _{OL} = 0.1mA			0.2	V
I _i	Input current	V _i = 0 ~ V _{cc}			±1	µA
I _o	Output current in off-state	$\overline{BC1}$ and $\overline{BC2}$ = V _{IH} or \overline{S} = V _{IH} or OE = V _{IH} , V _{I/O} = 0~ V _{cc}			±1	µA
I _{cc1W}	Word operation(16bit) Active supply current (AC,TTL level)	$\overline{BC1}$ and $\overline{BC2}$ = V _{IL} , \overline{S} = V _{IL} other inputs = V _{IH} or V _{IL} Output-open(duty 100%)	Min cycle	15	25	mA
I _{cc2W}			1MHz	7	10	mA
I _{cc1B}	Byte operation(8bit) Active supply current (AC,TTL level)	($\overline{BC1}$ = V _{IH} and $\overline{BC2}$ = V _{IL}) or ($\overline{BC1}$ = V _{IL} and $\overline{BC2}$ = V _{IH}), \overline{S} = V _{IL} , other inputs = V _{IH} or V _{IL} Output-open(duty 100%)	Min cycle	10	15	mA
I _{cc2B}			1MHz	5	8	mA
I _{cc3}	Stand-by current	1) \overline{S} V _{cc} -0.2V, other inputs = 0~V _{cc} 2) $\overline{BC1}$ and $\overline{BC2}$ V _{cc} -0.2V, \overline{S} 0.2V, other inputs = 0~V _{cc}	-LI		4	µA
			-HI		2	µA
I _{cc4}	Stand-by current	$\overline{BC1}$ and $\overline{BC2}$ = V _{IH} or \overline{S} = V _{IH} , other inputs = 0~V _{cc}			0.3	mA

* -1.0V in case of AC (Pulse width 30ns)

CAPACITANCE (T_a = - 40 ~85°C, V_{cc} = 1.8V~2.7V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
C _i	Input capacitance	V _i =GND, V _i =25mVrms, f=1MHz			6	pF
C _o	Output capacitance	V _o =GND, V _o =25mVrms, f=1MHz			10	pF

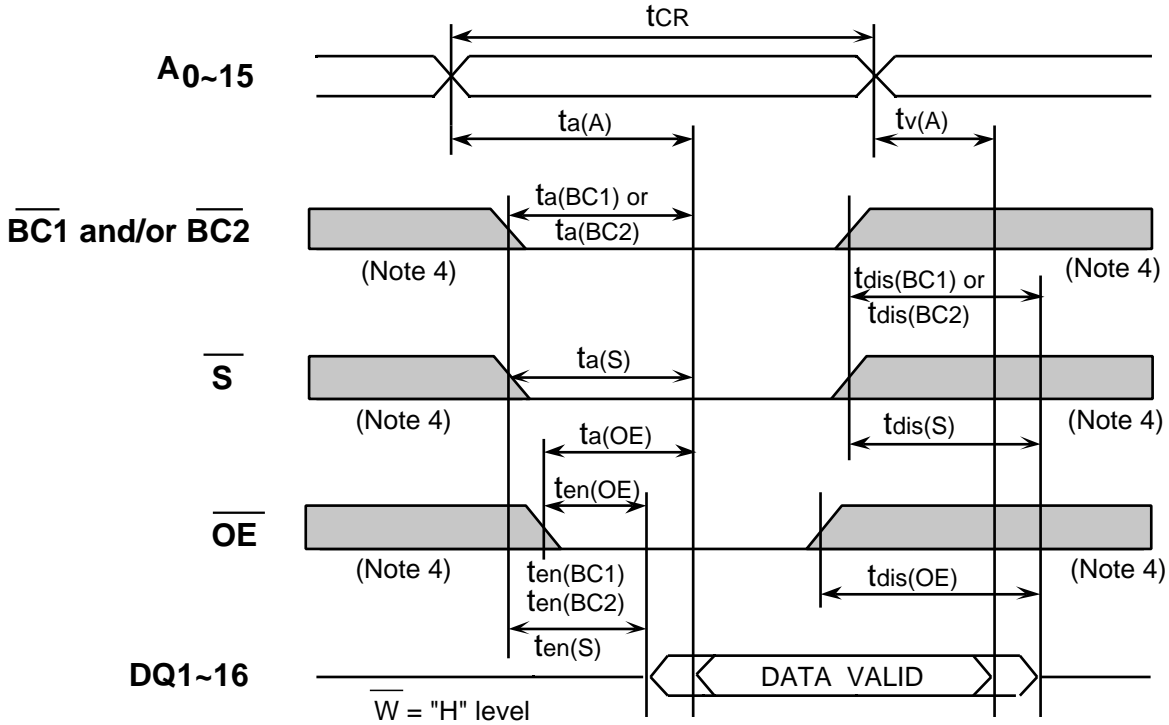
Note 1: Direction for current flowing into an IC is positive (no mark).

Note 2: Typical value is V_{cc} = 2.0V, T_a = 25°C

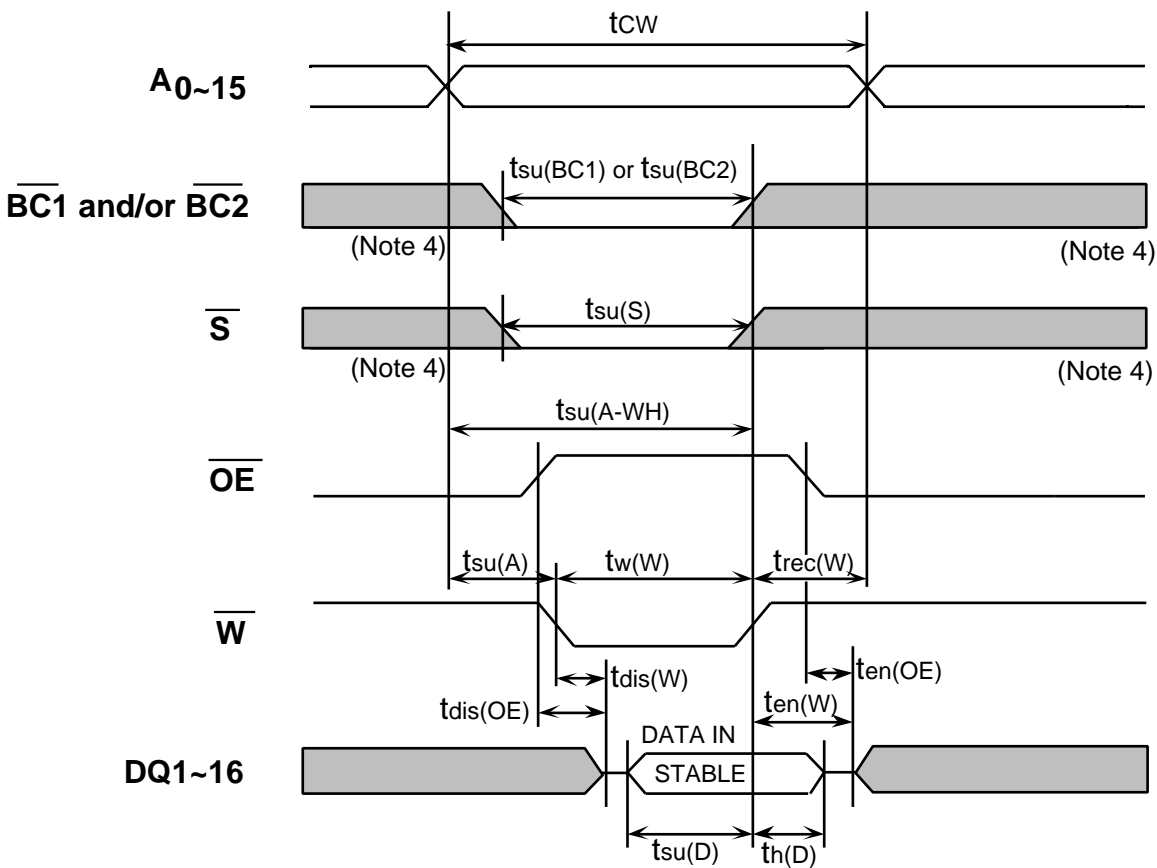
Note 3: C_i,C_o are periodically sampled and are not 100% tested.

(4) TIMING DIAGRAMS

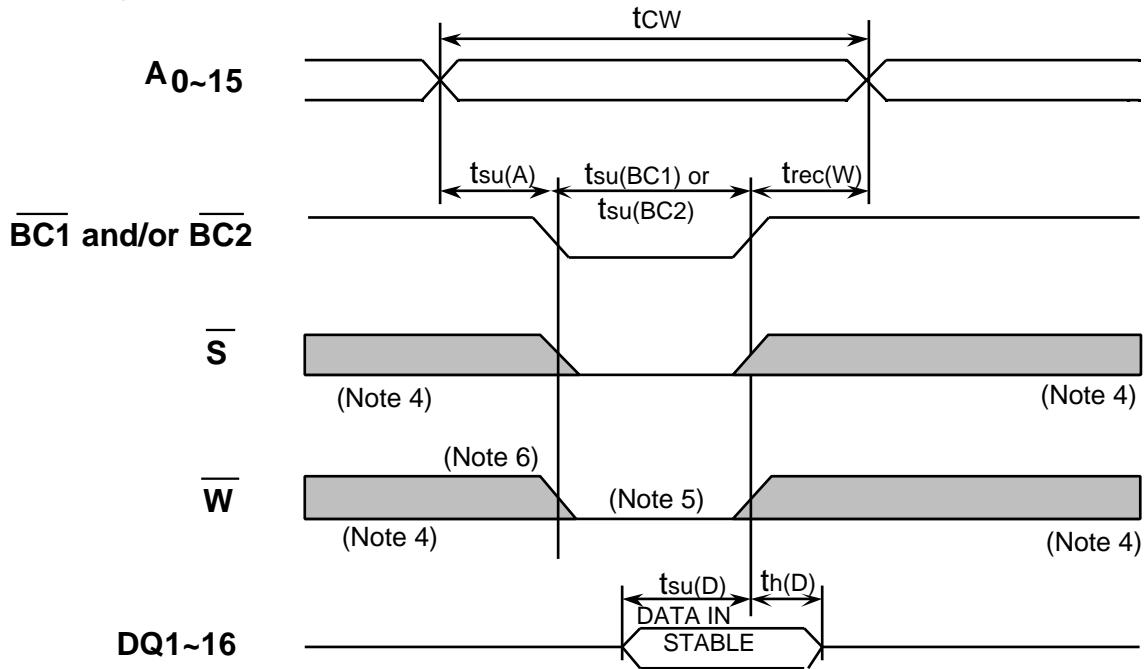
Read cycle



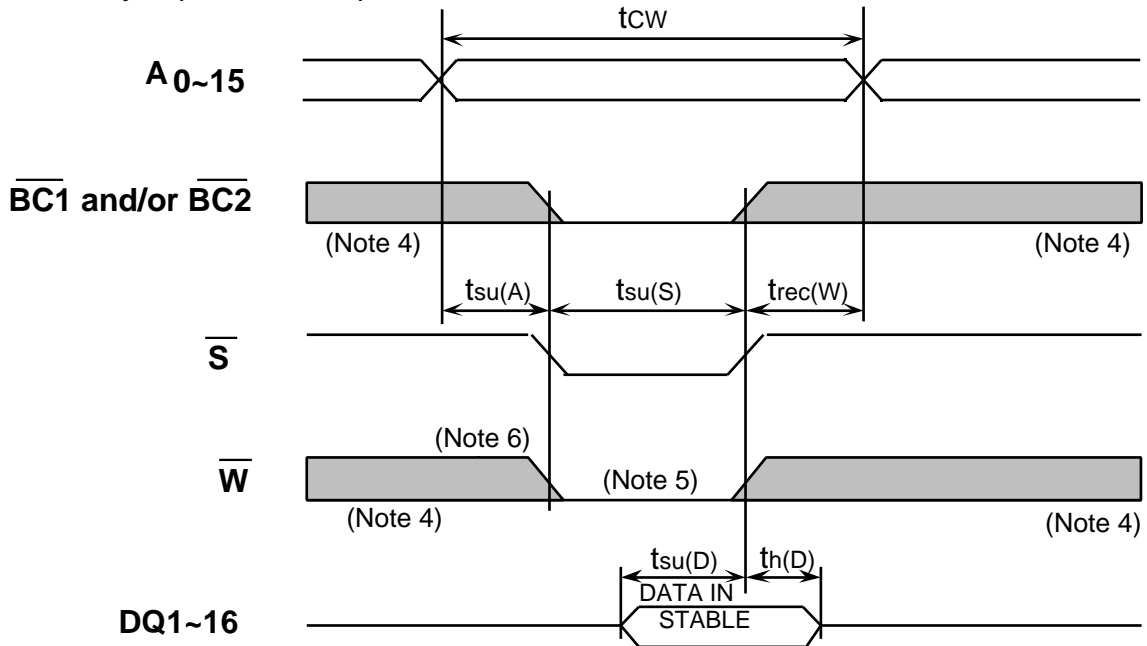
Write cycle (\overline{W} control mode)



Write cycle ($\overline{BC1}$, $\overline{BC2}$ control mode)



Write cycle (\overline{S} control mode)



Note 4: Hatching indicates the state is "don't care".

Note 5: Writing is executed while \overline{S} low overlaps $\overline{BC1}$ and/or $\overline{BC2}$ low and \overline{W} low.

Note 6: When the falling edge of \overline{W} is simultaneously or prior to the falling edge of $\overline{BC1}$ and/or $\overline{BC2}$ or falling edge of \overline{S} , the outputs are maintained in the high impedance state.

Note 7: Don't apply inverted phase signal externally when DQ pin is output mode.

Note 8: t_{en} , t_{dis} are periodically sampled and are not 100% tested.

Note 9: t_{CR} (Read cycle time) is defined as whole time from reading address set up to this address change under read mode set condition by \overline{S} , \overline{W} , \overline{OE} , $\overline{BC1}$ and/or $\overline{BC2}$.

Note 10: t_{CW} (Write cycle time) is defined as whole time from writing address set up to this address change under write mode set condition by \overline{S} , \overline{W} , $\overline{BC1}$ and/or $\overline{BC2}$.

POWER DOWN CHARACTERISTICS

(1) ELECTRICAL CHARACTERISTICS (Ta = - 40~85°C, unless otherwise noted)

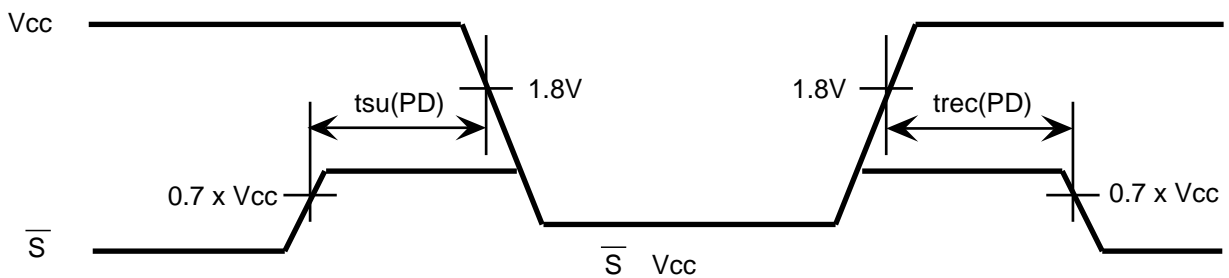
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V _{cc(PD)}	Power down supply voltage		1.0			V
V _{I(S)}	Chip select input \bar{S}	1.8V V _{cc(PD)}	0.7 x V _{cc}			V
		1.0V V _{cc(PD)} 1.8V		V _{cc(PD)}		
V _{I(BC)}	Byte control inputs $\bar{BC}1$ and $\bar{BC}2$	1.8V V _{cc(PD)}	0.7 x V _{cc}			V
		1.0V V _{cc(PD)} 1.8V		V _{cc(PD)}		
I _{cc(PD)}	Power down supply current	V _{cc} = 2.0V 1) \bar{S} V _{cc} - 0.2V other inputs = 0~V _{cc}	-LI		2	μA
		2) $\bar{BC}1$ and $\bar{BC}2$ V _{cc} - 0.2V \bar{S} 0.2V, other inputs = 0~V _{cc}	-HI	0.05	1	

(2) TIMING REQUIREMENTS (Ta = - 40 ~85°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
tsu(PD)	Power down set up time		0			ns
trec(PD)	Power down recovery time		5			ms

(3) POWER DOWN CHARACTERISTICS

\bar{S} control mode



$\bar{BC}1$ and $\bar{BC}2$ control mode

