To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M5M5V416BTP,RT

4194304-BIT (262144-WORD BY 16-BIT) CMOS STATIC RAM

DESCRIPTION

The M5M5V416B is a family of low voltage 4-Mbit static RAMs organized as 262,144-words by 16-bit, fabricated by Mitsubishi's high-performance 0.25µm CMOS technology.

The M5M5V416B is suitable for memory applications where a simple interfacing, battery operating and battery backup are the important design objectives.

M5M5V416BTP,RT are packaged in a 44-pin 400mil thin small outline package. M5M5V416BTP (normal lead bend type package), M5M5V416BRT (reverse lead bend type package), both types are very easy to design a printed circuit board.

From the point of operating temperature, the family is divided into three versions; "Standard", "W-version", and "I-version". Those are summarized in the part name table below.

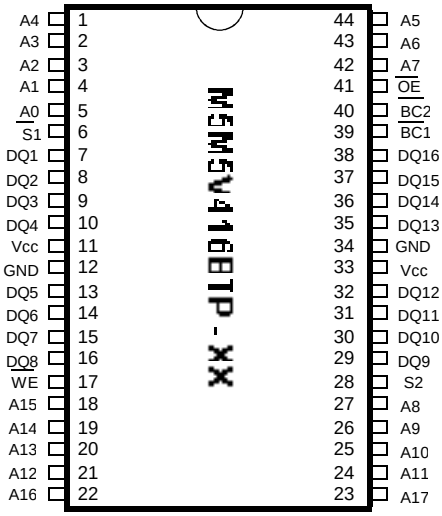
FEATURES

- Single +2.7~+3.6V power supply
- Small stand-by current: 0.3µA(3V,typ.)
- No clocks, No refresh
- Data retention supply voltage=2.0V to 3.6V
- All inputs and outputs are TTL compatible.
- Easy memory expansion by $\overline{S1}$, S2, $\overline{BC1}$ and $\overline{BC2}$
- Common Data I/O
- Three-state outputs: OR-tie capability
- $\overline{OE}$ prevents data contention in the I/O bus
- Process technology: 0.25µm CMOS
- Package: 44 pin 400mil TSOP (II)

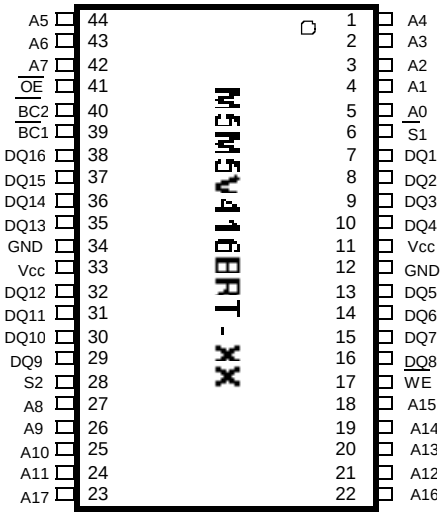
Version, Operating temperature	Part name	Power Supply	Access time max.	Stand-by current Icc(PD), Vcc=3.0V typical *		Stand-by current Icc(PD), Vcc=3.0V Ratings (max.)				Active current Icc1 (3.0V, typ.)
				25°C	40°C	25°C	40°C	70°C	85°C	
I-version -40 ~ +85°C	M5M5V416BTP,RT -70HI	2.7 ~ 3.6V	70ns	0.3µA	1µA	1µA	3µA	15µA	30µA	50mA (10MHz) 7mA (1MHz)

* "typical" parameter is sampled, not 100% tested.

PIN CONFIGURATION



44P3W-H



44P3W-J

Pin	Function
A0 ~ A17	Address input
DQ1 ~ DQ16	Data input / output
$\overline{S1}$	Chip select input 1
S2	Chip select input 2
$\overline{W}$	Write control input
$\overline{OE}$	Output enable input
$\overline{BC1}$	Lower Byte (DQ1 ~ 8)
$\overline{BC2}$	Upper Byte (DQ9 ~ 16)
Vcc	Power supply
GND	Ground supply

Outline: 44P3W-H/J

NC: No Connection

M5M5V416BTP,RT

4194304-BIT (262144-WORD BY 16-BIT) CMOS STATIC RAM

FUNCTION

The M5M5V416BTP,RT are organized as 262,144-words by 16-bit. These devices operate on a single +2.7~3.6V power supply, and are directly TTL compatible to both input and output. Its fully static circuit needs no clocks and no refresh, and makes it useful.

The operation mode are determined by a combination of the device control inputs $\overline{BC1}$, $\overline{BC2}$, $\overline{S1}$, S2 , $\overline{W}$ and $\overline{OE}$. Each mode is summarized in the function table.

A write operation is executed whenever the low level $\overline{W}$ overlaps with the low level $\overline{BC1}$ and/or $\overline{BC2}$ and the low level $\overline{S1}$ and the high level S2. The address(A0~A17) must be set up before the write cycle and must be stable during the entire cycle.

A read operation is executed by setting $\overline{W}$ at a high level and $\overline{OE}$ at a low level while $\overline{BC1}$ and/or $\overline{BC2}$ and $\overline{S1}$ and S2 are in an active state($\overline{S1}$=L,S2=H).

When setting $\overline{BC1}$ at the high level and other pins are in an active stage , 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 $\overline{BC2}$ at a high level and other pins are in an active stage, lower-byte are in a selectable mode and upper-byte are in a non-selectable mode. When setting $\overline{BC1}$ and $\overline{BC2}$ at a high level or $\overline{S1}$ at a high level or S2 at a low 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 OR-tie with other chips and memory expansion by $\overline{BC1}$, $\overline{BC2}$ and $\overline{S1}$, S2.

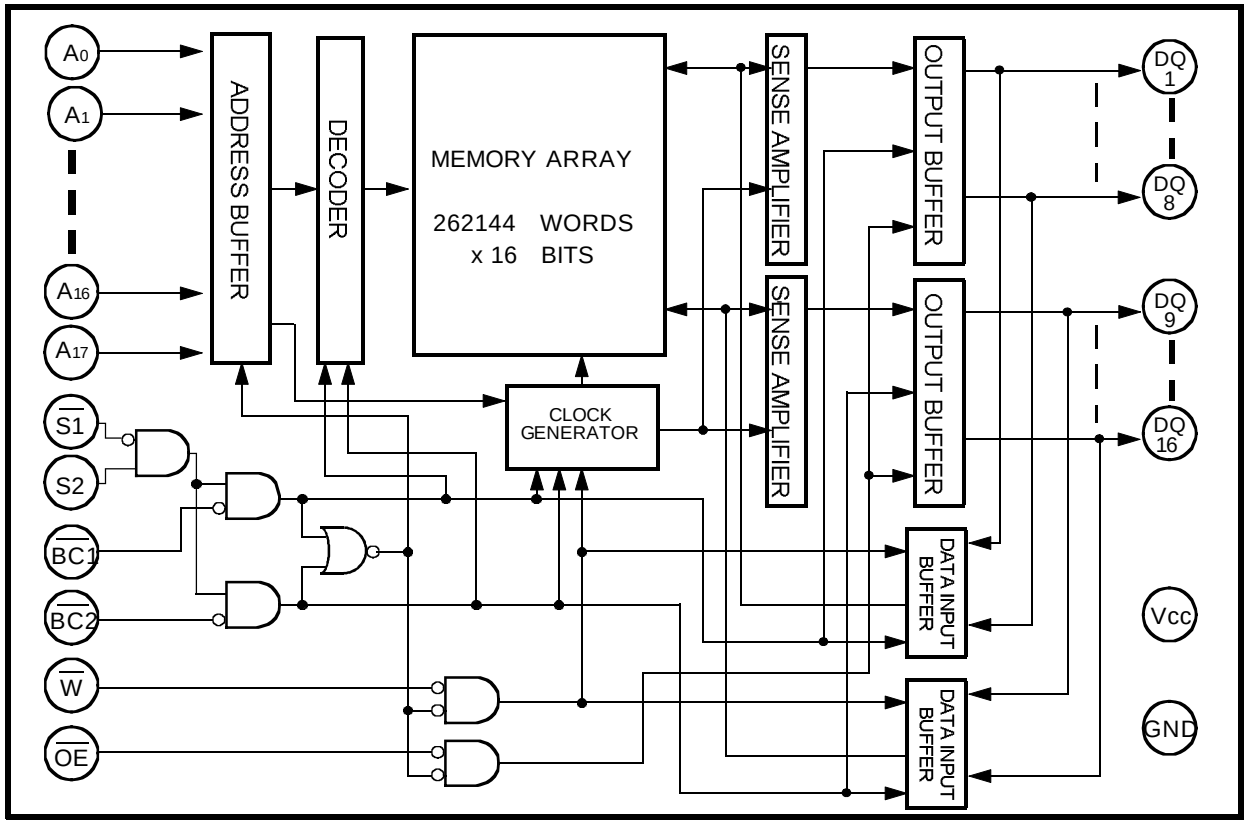
The power supply current is reduced as low as 0.3µA(25°C, typical), and the memory data can be held at +2V power supply, enabling battery back-up operation during power failure or power-down operation in the non-selected mode.

FUNCTION TABLE

$\overline{S1}$	S2	$\overline{BC1}$	$\overline{BC2}$	$\overline{W}$	$\overline{OE}$	Mode	DQ1~8	DQ9~16	Icc
H	L	X	X	X	X	Non selection	High-Z	High-Z	Standby
L	L	X	X	X	X	Non selection	High-Z	High-Z	Standby
H	H	X	X	X	X	Non selection	High-Z	High-Z	Standby
X	X	H	H	X	X	Non selection	High-Z	High-Z	Standby
L	H	L	H	L	X	Write	Din	High-Z	Active
L	H	L	H	H	L	Read	Dout	High-Z	Active
L	H	L	H	H	H	———	High-Z	High-Z	Active
L	H	H	L	L	X	Write	High-Z	Din	Active
L	H	H	L	H	L	Read	High-Z	Dout	Active
L	H	H	L	H	H	———	High-Z	High-Z	Active
L	H	L	L	L	X	Write	Din	Din	Active
L	H	L	L	H	L	Read	Dout	Dout	Active
L	H	L	L	H	H	———	High-Z	High-Z	Active

(note) "H" and "L" in this table mean VIH and VIL respectively. "X" in this table should be "H" or "L".

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Units
V_{CC}	Supply voltage	With respect to GND	-0.5* ~ +4.6	V
V_I	Input voltage	With respect to GND	-0.5* ~ Vcc + 0.5	
V_O	Output voltage	With respect to GND	0 ~ Vcc	
P_d	Power dissipation	Ta=25°C	700	mW
T_a	Operating temperature	I-version	- 40 ~ +85	°C
T_{stg}	Storage temperature		- 65 ~ +150	°C

* -3.0V in case of AC (Pulse width ≦ 30ns)

DC ELECTRICAL CHARACTERISTICS

(Vcc=2.7 ~ 3.6V, unless otherwise noted)

Symbol	Parameter	Conditions		Limits Min	Limits Typ	Limits Max	Units
V_{IH}	High-level input voltage			2.2		Vcc+0.3V	V
V_{IL}	Low-level input voltage			-0.3 *		0.6	
V_{OH1}	High-level output voltage 1	I_{OH}= -0.5mA		2.4			
V_{OH2}	High-level output voltage 2	I_{OH}= -0.05mA		Vcc-0.5V			
V_{OL}	Low-level output voltage	I_{OL}=2mA				0.4	
I_I	Input leakage current	V_I=0 ~ Vcc				±1	µA
I_O	Output leakage current	$\overline{BC1}$ and $\overline{BC2}$=VIH or $\overline{S1}$=VIH or S2=VIH or $\overline{OE}$=VIH, VI/O=0 ~ Vcc				±1	
Icc1	Active supply current (AC,MOS level)	$\overline{BC1}$ and $\overline{BC2}$≦ 0.2V, $\overline{S1}$≦ 0.2V, S2 ≧ Vcc-0.2V other inputs ≦0.2V or ≧Vcc-0.2V Output - open (duty 100%)	f= 10MHz	-	50	70	mA
			f= 1MHz	-	7	15	
Icc2	Active supply current (AC,TTL level)	$\overline{BC1}$ and $\overline{BC2}$=VIL , $\overline{S}$=VIL ,S2=VIH other pins =VIH or VIL Output - open (duty 100%)	f= 10MHz	-	50	70	
			f= 1MHz	-	7	15	
Icc3	Stand by supply current (AC,MOS level)	< 1 > $\overline{S1}$ ≧ Vcc - 0.2V, other inputs = 0 ~ Vcc < 2 > S2 ≦0.2V, other inputs = 0 ~ Vcc < 3 > $\overline{BC1}$ and $\overline{BC2}$ ≧Vcc - 0.2V $\overline{S1}$≦ 0.2V, S2 ≧Vcc - 0.2V Other inputs=0~Vcc	+85°C	-	-	40	µA
			+70°C	-	-	20	
			+40°C	-	1	5.0	
			0 ~ +25°C	-	0.3	2.0	
			- 20 ~ +25°C	-	0.3	2.0	
			- 40 ~ +25°C	-	0.3	2.0	
Icc4	Stand by supply current (AC,TTL level)	$\overline{BC1}$ and $\overline{BC2}$=VIH or $\overline{S1}$=VIH or S2=VIL Other inputs= 0 ~ Vcc		-	-	0.5	mA

Note 1: Direction for current flowing into IC is indicated as positive (no mark)

Note 2: Typical value is for Vcc=3.0V and Ta=25°C

* -3.0V in case of AC (Pulse width ≦ 30ns)

CAPACITANCE

(Vcc=2.7 ~ 3.6V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits Min	Limits Typ	Limits Max	Units
C_I	Input capacitance	V_I=GND, V_I=25mVrms, f=1MHz			10	pF
C_O	Output capacitance	V_O=GND, V_O=25mVrms, f=1MHz			10	

AC ELECTRICAL CHARACTERISTICS

(Vcc=2.7 ~ 3.6V, unless otherwise noted)

(1) TEST CONDITIONS

Supply voltage	2.7V~3.6V
Input pulse	V_{IH}=2.4V,V_{IL}=0.4V
Input rise time and fall time	5ns
Reference level	V_{OH}=V_{OL}=1.5V Transition is measured ±500mV from steady state voltage.(for t_{en},t_{dis})
Output loads	Fig.1,CL=30pF CL=5pF (for ten,tdis)

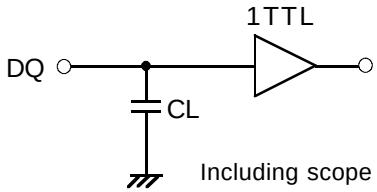


Fig.1 Output load

(2) READ CYCLE

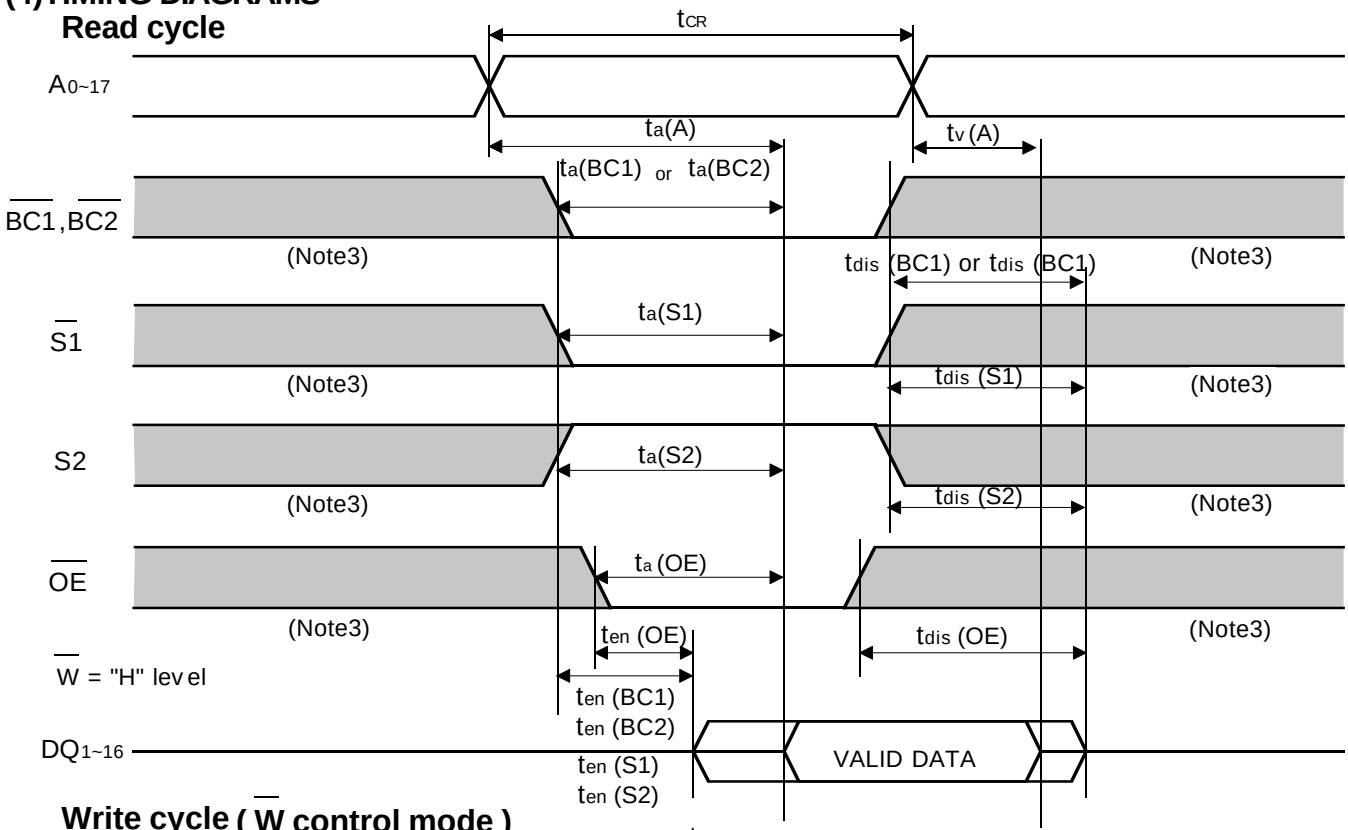
Symbol	Parameter	Limits		Units
		Min	Max	
t_{CR}	Read cycle time	70		ns
t_a(A)	Address access time		70	ns
t_a(S1)	Chip select 1 access time		70	ns
t_a(S2)	Chip select 2 access time		70	ns
t_a(BC1)	Byte control 1 access time		70	ns
t_a(BC2)	Byte control 2 access time		70	ns
t_a(OE)	Output enable access time		35	ns
t_{dis}(S1)	Output disable time after $\overline{S1}$ high		25	ns
t_{dis}(S2)	Output disable time after S2 low		25	ns
t_{dis}(BC1)	Output disable time after $\overline{BC1}$ high		25	ns
t_{dis}(BC2)	Output disable time after $\overline{BC2}$ high		25	ns
t_{dis}(OE)	Output disable time after $\overline{OE}$ high		25	ns
t_{en}(S1)	Output enable time after $\overline{S1}$ low	10		ns
t_{en}(S2)	Output enable time after S2 high	10		ns
t_{en}(BC1)	Output enable time after $\overline{BC1}$ low	10		ns
t_{en}(BC2)	Output enable time after $\overline{BC2}$ low	10		ns
t_{en}(OE)	Output enable time after $\overline{OE}$ low	5		ns
t_v(A)	Data valid time after address	10		ns

(3) WRITE CYCLE

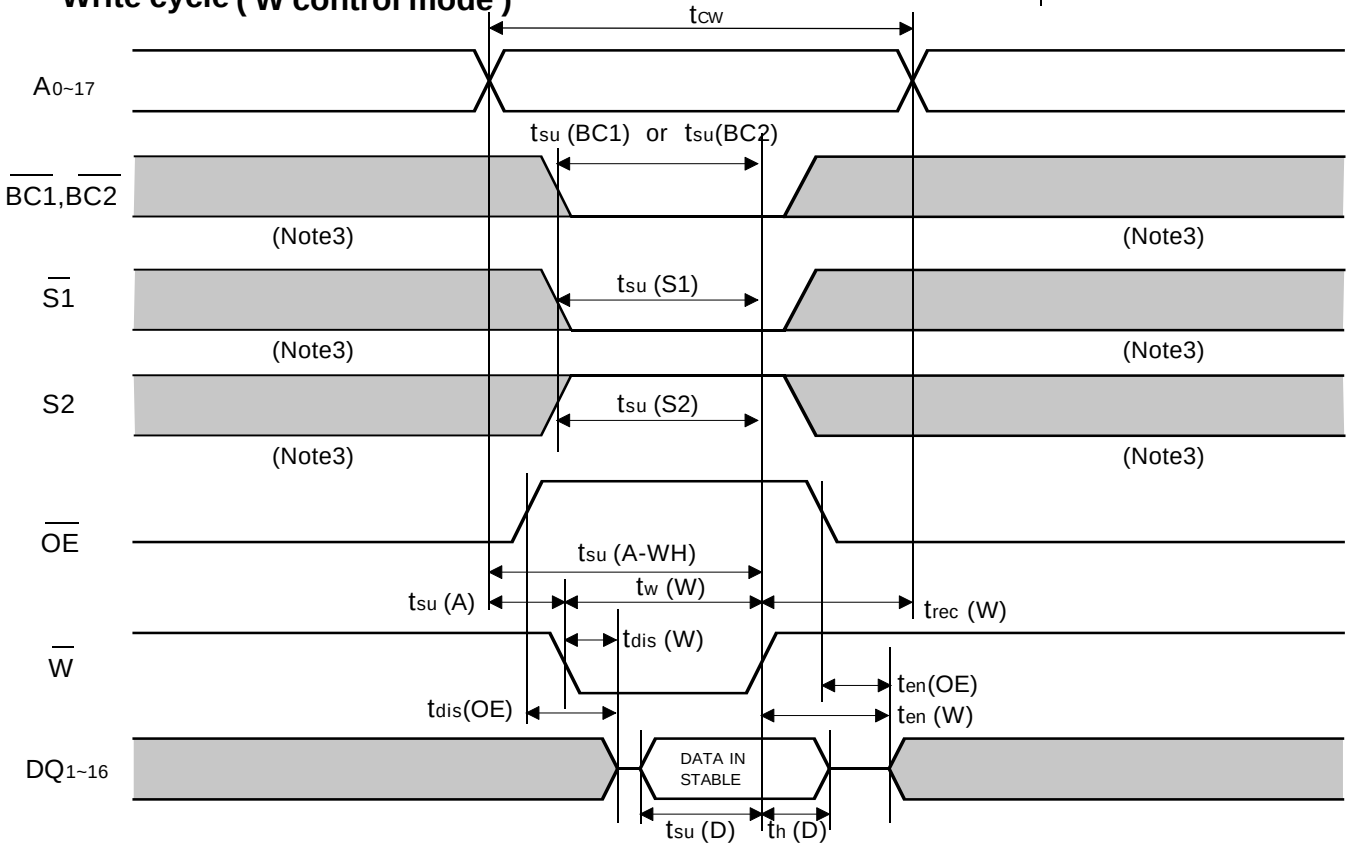
Symbol	Parameter	Limits		Units
		Min	Max	
t_{CW}	Write cycle time	70		ns
t_w(W)	Write pulse width	55		ns
t_{su}(A)	Address setup time	0		ns
t_{su}(A-WH)	Address setup time with respect to $\overline{W}$	60		ns
t_{su}(BC1)	Byte control 1 setup time	60		ns
t_{su}(BC2)	Byte control 2 setup time	60		ns
t_{su}(S1)	Chip select 1 setup time	60		ns
t_{su}(S2)	Chip select 2 setup time	60		ns
t_{su}(D)	Data setup time	35		ns
t_h(D)	Data hold time	0		ns
t_{rec}(W)	Write recovery time	0		ns
t_{dis}(W)	Output disable time from $\overline{W}$ low		25	ns
t_{dis}(OE)	Output disable time from $\overline{OE}$ high		25	ns
t_{en}(W)	Output enable time from $\overline{W}$ high	5		ns
t_{en}(OE)	Output enable time from $\overline{OE}$ low	5		ns

(4)TIMING DIAGRAMS

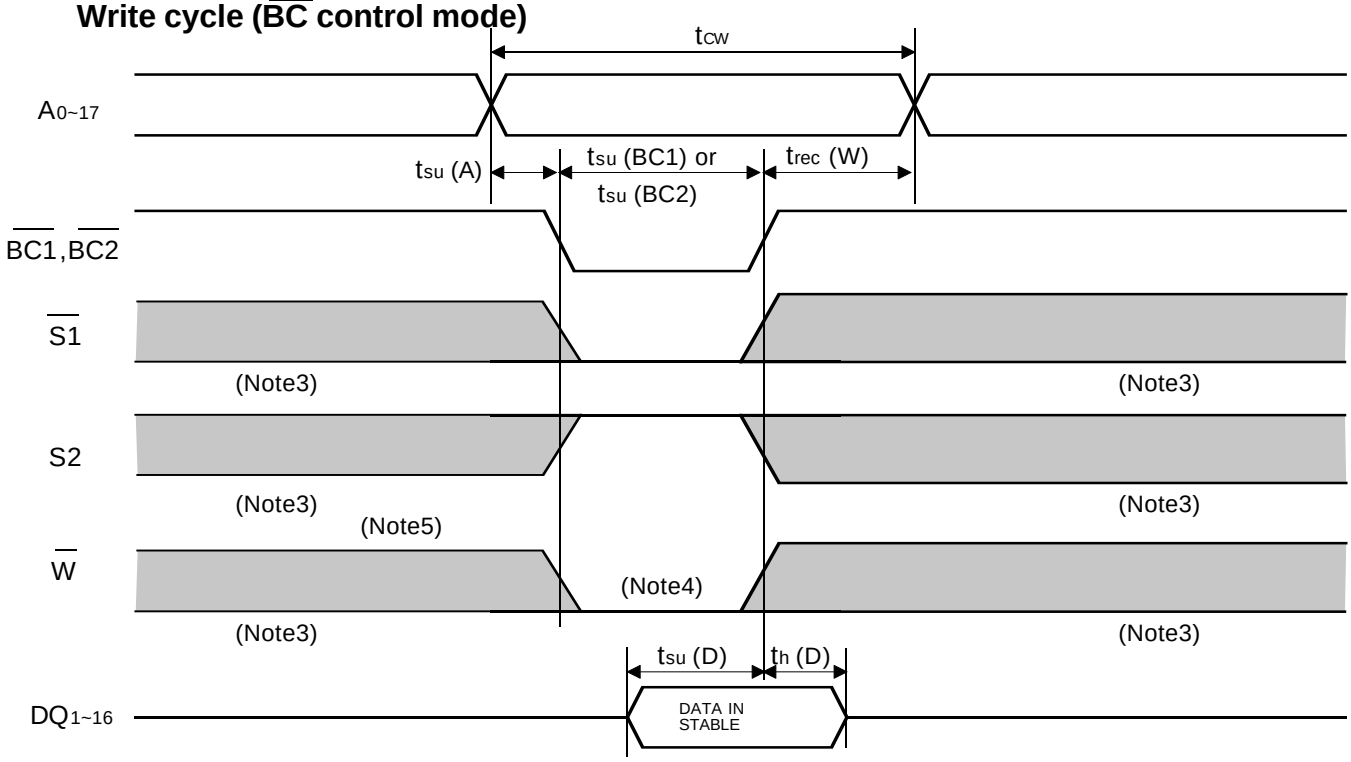
Read cycle



Write cycle ($\overline{W}$ control mode)



Write cycle ($\overline{BC}$ control mode)



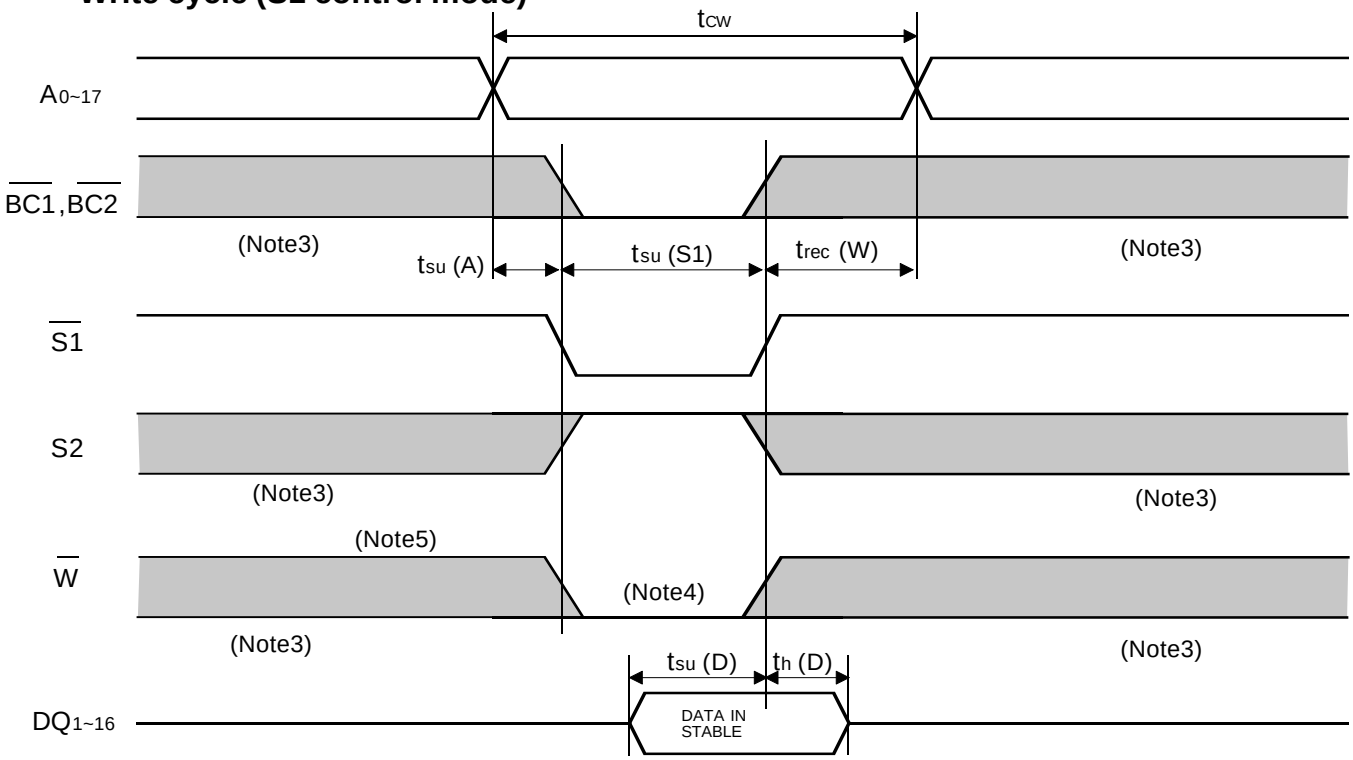
Note 3: Hatching indicates the state is "don't care".

Note 4: A Write occurs during S1 low, S2 high overlaps BC1 and/or BC2 low and W low.

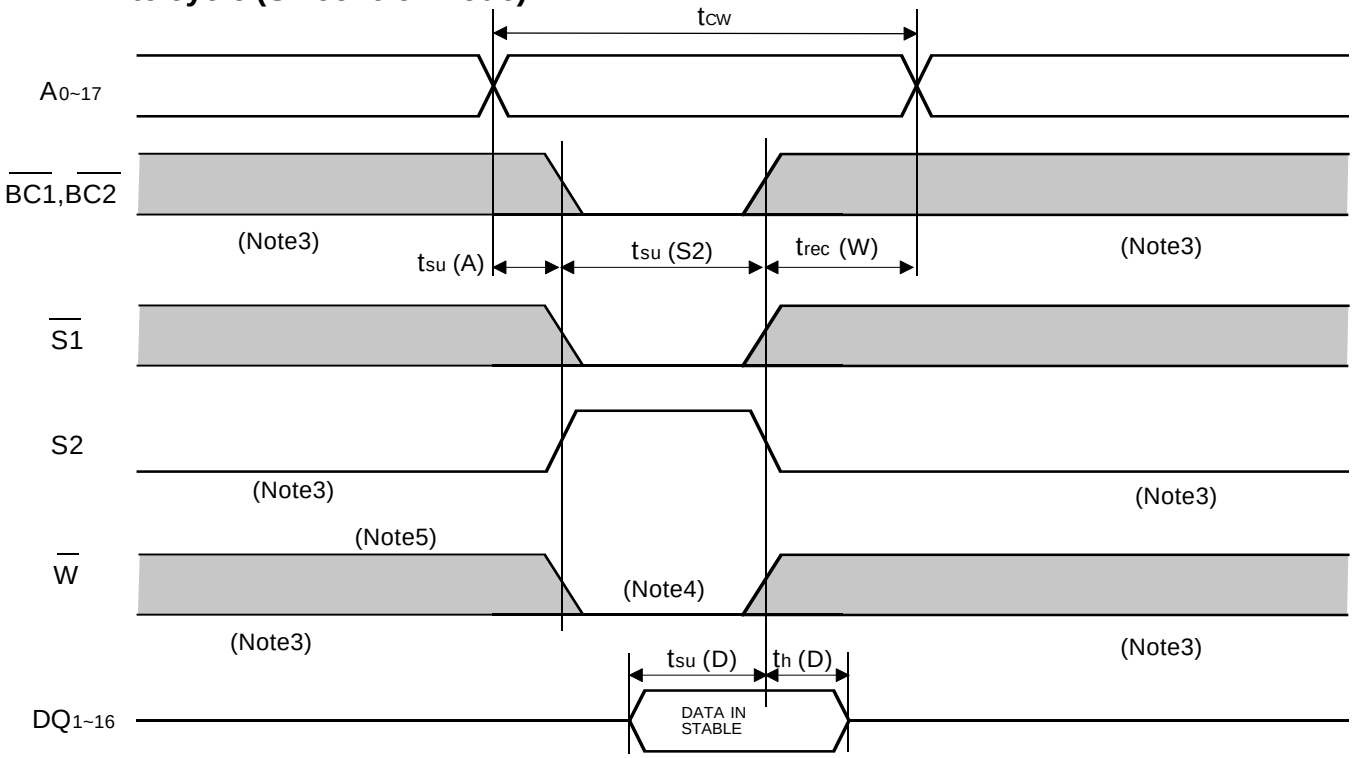
Note 5: When the falling edge of W is simultaneously or prior to the falling edge of BC1 and/or BC2 or the falling edge of S1 or rising edge of S2, the outputs are maintained in the high impedance state.

Note 6: Don't apply inverted phase signal externally when DQ pin is in output mode.

Write cycle ($\overline{S1}$ control mode)



Write cycle (S2 control mode)



POWER DOWN CHARACTERISTICS

(1) ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions		Limits Min	Limits Typ	Limits Max	Units
Vcc (PD)	Power down supply voltage			2.0			V
VI (BC)	Byte control input $\overline{BC1}$ & $\overline{BC2}$			2.0			V
VI ($\overline{S1}$)	Chip select input $\overline{S1}$			2.0			V
VI (S2)	Chip select input S2					0.2	V
Icc (PD)	Power down supply current	Vcc=3.0V < 1 > $\overline{S1} \geqq$ Vcc - 0.2V S2 $\geqq$ Vcc - 0.2V or $\leqq$ 0.2V other inputs=0~3V < 2 > S2 $\leqq$ 0.2V other inputs=0~3V < 3 > $\overline{BC1}$ and $\overline{BC2} \geqq$ Vcc-0.2V $\overline{S1} \leqq$ 0.2V or S2 $\geqq$ Vcc-0.2V other inputs=0~3V	+85°C	-	-	30	µA
			+70°C	-	-	15	µA
			+40°C	-	1	3	µA
			0 ~ +25°C	-	0.3	1	µA
			-20 ~ +25°C	-	0.3	1	µA
			-40 ~ +25°C	-	0.3	1	µA

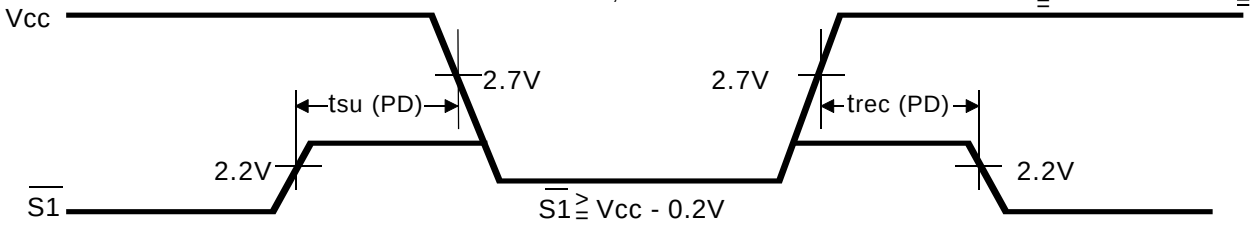
Typical value is for Ta=25°C

(2) TIMING REQUIREMENTS

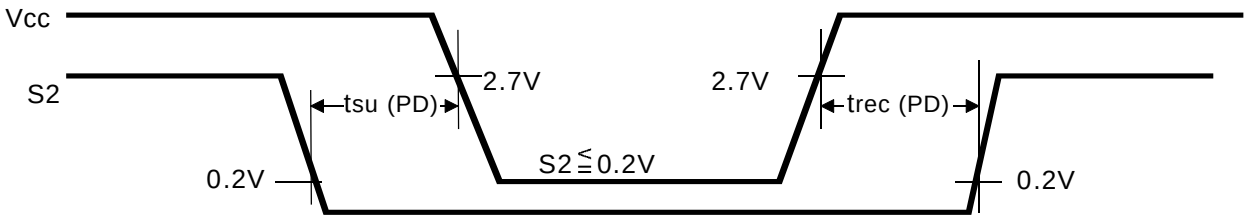
Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Units
$t_{su\ (PD)}$	Power down set up time		0			ns
$t_{rec\ (PD)}$	Power down recovery time		5			ms

(3) TIMING DIAGRAM

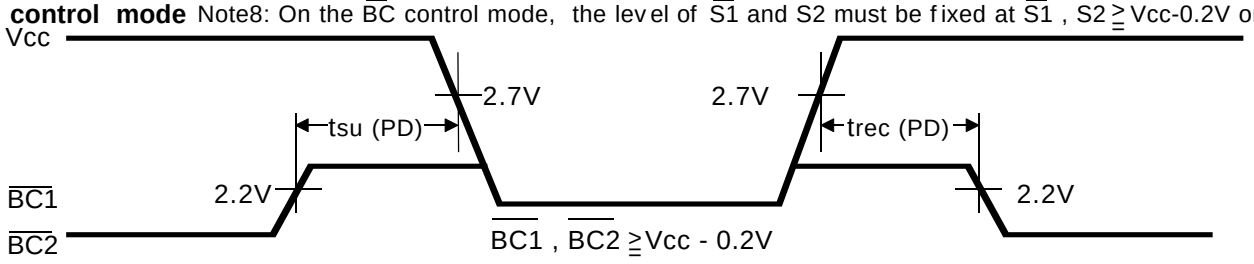
$\overline{S1}$ control mode Note7: On the $\overline{S1}$ control mode, the level of S2 must be fixed at S2 $\geqq$ Vcc-0.2V or S2 $\leqq$ 0.2V.



S2 control mode



$\overline{BC}$ control mode Note8: On the $\overline{BC}$ control mode, the level of $\overline{S1}$ and S2 must be fixed at $\overline{S1}$, S2 $\geqq$ Vcc-0.2V or S2 $\leqq$ 0.2



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