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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

M5M5408BFP/TP/RT

4194304-BIT (524288-WORD BY 8-BIT) CMOS STATIC RAM

DESCRIPTION

The M5M5408B is a family of 4-Mbit static RAMs organized as 524,288-words by 8-bit, fabricated by Mitsubishi's high-performance 0.25μm CMOS technology.

The M5M5408B is suitable for memory applications where a simple interfacing, battery operating and battery backup are the important design objectives.

M5M5408B is packaged in 32-pin plastic SOP, 32-pin plastic TSOP. Two types of TSOPs are available, M5M5408BTP (normal-lead-bend TSOP), M5M5408BRT (reverse-lead-bend TSOP). These two types TSOPs are suitable for a surface mounting on double-sided printed circuit boards.

From the point of operating temperature, the family is divided into two versions; "Standard" and "I-version". Those are

FEATURES

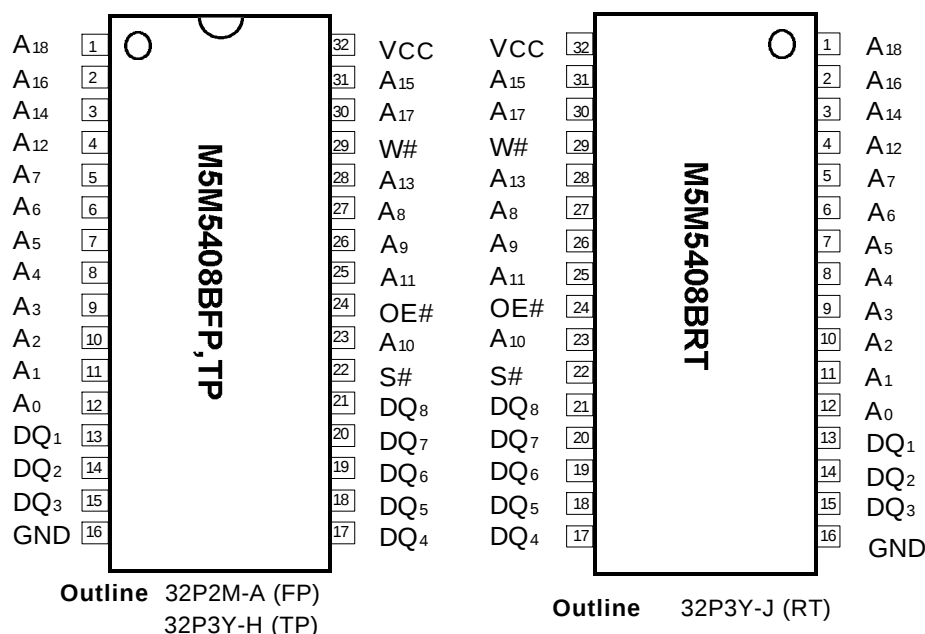
- Single +5V power supply
- Small stand-by current: 0.4μA(3V,typ.)
- No clocks, No refresh
- Data retention supply voltage=2.0V to 5.5V
- All inputs and outputs are TTL compatible.
- Easy memory expansion by S#
- Common Data I/O
- Three-state outputs: OR-tie capability
- OE# prevents data contention in the I/O bus
- Process technology: 0.25μm CMOS
- Package:
 - M5M5408BFP: 32 pin 525 mil SOP
 - M5M5408BTP/RT: 32 pin 400 mil TSOP(II)

PART NAME TABLE

Version, Operating temperature	Part name (## stands for "FP", "TP", and "RT")	Power Supply	Access time max.	Stand-by current Icc(PD), Vcc=3.0V				Active current Icc1 (5.0V, typ. *)
				typical *	Limits (max.)			
				25°C	25°C	70°C	85°C	
Standard 0 ~ +70°C	M5M5408B## -55F	5.0V	55ns	0.4μA	1μA	15μA	---	50mA (10MHz)
	M5M5408B## -70F		70ns					
I-v ersion -40 ~ +85°C	M5M5408B## -55H	5.0V	55ns	0.4μA	1μA	15μA	30μA	25mA (1MHz)
	M5M5408B## -70H		70ns					

*Typical values are sampled, and are not 100% tested.

PIN CONFIGURATION (TOP VIEW)



Pin	Function
A0 ~ A18	Address input
DQ1 ~ DQ8	Data input / output
S# ($\bar{S}$)	Chip select input
W# ($\bar{W}$)	Write control input
OE# ($\bar{OE}$)	Output inable input
Vcc	Power supply
GND	Ground supply

M5M5408BFP/TP/RT

4194304-BIT (524288-WORD BY 8-BIT) CMOS STATIC RAM

FUNCTION

The M5M5408BFP,TP,RT is organized as 524,288-words by 8-bit. These devices operate on a single +5.0V 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.

A write operation is executed during the S# low and W# low overlap time. The address(A0~A18) must be set up before the write cycle

A read operation is executed by setting W# at a high level and OE# at a low level while S# are in an active state (S#=L).

When setting 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 OR-tie with other chips. Setting the 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.

The power supply current is reduced as low as 0.4μA (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.

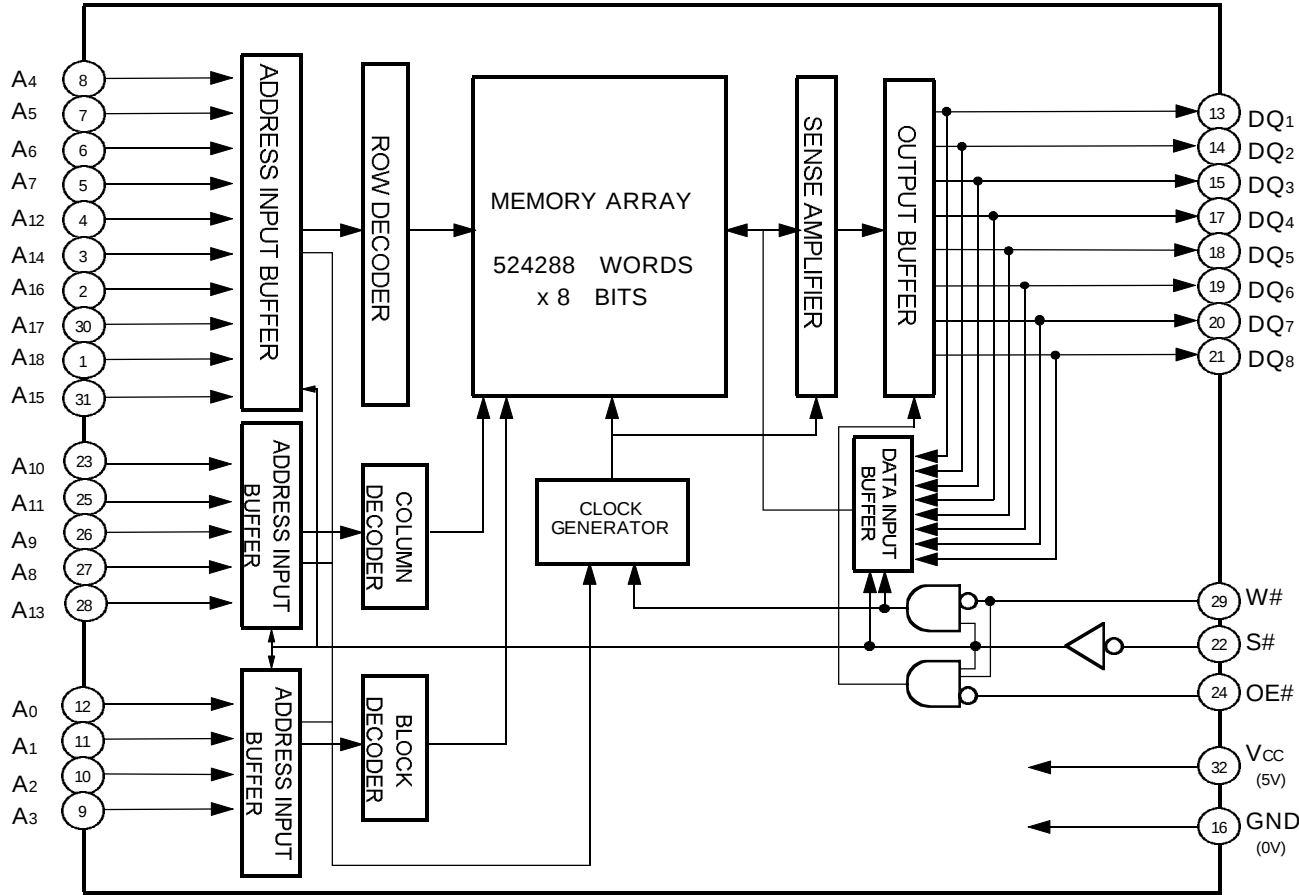
FUNCTION TABLE

S#	W#	OE#	Mode	DQ	Icc
H	X	X	Non selection	High-impedance	Standby
L	L	X	Write	Data input (D)	Active
L	H	L	Read	Data output (Q)	Active
L	H	H	Read	High-impedance	Active

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

Pin	Function
A0 ~ A18	Address input
DQ1 ~ DQ8	Data input / output
S# ($\overline{S}$)	Chip select input
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BLOCK DIAGRAM



M5M5408BFP/TP/RT**4194304-BIT (524288-WORD BY 8-BIT) CMOS STATIC RAM****ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Conditions	Ratings	Units
V _{CC}	Supply voltage	With respect to GND	-0.3* ~ +7	V
V _I	Input voltage	With respect to GND	-0.3* ~ V _{CC} + 0.3	
V _O	Output voltage	With respect to GND	0 ~ V _{CC}	
P _d	Power dissipation	T _a =25°C	700	mW
T _a	Operating temperature	Standard	0 ~ +70	°C
		I-version	-40 ~ +85	
T _{stg}	Storage temperature		-65 ~ +150	°C

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

DC ELECTRICAL CHARACTERISTICS(V_{CC}= 5V ±10%, unless otherwise noted)

Symbol	Parameter	Conditions	Limits			Units
			Min	Typ.	Max	
V _{IH}	High-level input voltage		2.2		V _{CC} +0.3V	V
V _{IL}	Low-level input voltage		-0.3 *		0.8	
V _{OH1}	High-level output voltage 1	I _{OH} = -1mA	2.4			
V _{OH2}	High-level output voltage 2	I _{OH} = -0.1mA	V _{CC} -0.5V			
V _{OL}	Low-level output voltage	I _{OL} =2mA			0.4	
I _I	Input leakage current	V _I =0 ~ V _{CC}			±1	μA
I _O	Output leakage current	S# = V _{IH} or OE# = V _{IH} , V _{I/O} = 0 ~ V _{CC}			±1	
I _{CC1}	Active supply current (CMOS-level input)	S# ≤ 0.2V, output-open Other inputs ≤ 0.2V or ≥ V _{CC} -0.2V	f=10MHz	-	50	mA
			f=1MHz	-	25	
I _{CC2}	Active supply current (TTL-level input)	S# = V _{IL} , output-open Other inputs= V _{IH} or V _{IL}	f=10MHz	-	60	
			f=1MHz	-	30	
I _{CC3}	Stand by supply current (CMOS-level input)	V _{CC} = 5.5V, max. S# ≥ V _{CC} -0.2V, other inputs=0~V _{CC}	Standard	-	1.0	μA
			I-version	-	1.0	
I _{CC4}	Stand by supply current (TTL-level input)	S# = V _{IH} , other inputs= 0 ~ V _{CC}	-	-	3	mA

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

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

Note 2: Typical values are sampled at V_{CC}=5.0V and T_a=25°C,
and are not 100% tested.**CAPACITANCE**(V_{CC}=5.0V±10%, unless otherwise noted)

Symbol	Parameter	Conditions	Limits			Units
			Min	Typ.	Max	
C _I	Input capacitance	V _I =GND, V _I =25mVrms, f=1MHz			8	pF
C _O	Output capacitance	V _O =GND, V _O =25mVrms, f=1MHz			10	

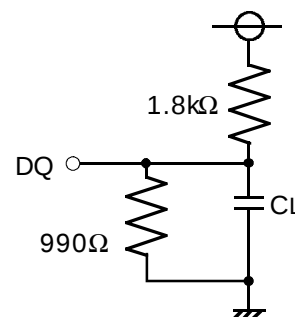
M5M5408BFP/TP/RT

4194304-BIT (524288-WORD BY 8-BIT) CMOS STATIC RAM

AC ELECTRICAL CHARACTERISTICS (V_{CC}=5.0V±10%, unless otherwise noted)

(1) TEST CONDITIONS

Supply voltage	5.0V
Input pulse	V _{IH} =2.4V, V _{IL} =0.6V (-70H, -70HI) V _{IH} =3.0V, V _{IL} =0V (-55H, -55HI)
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} and t _{dis} .
Output loads	Fig.1, CL=100pF (-70H, -70HI) CL=30pF (-55H, -55HI) CL=5pF (for t _{en} , t _{dis})



CL Includes scope and jig capacitance

Fig.1 Output load

(2) READ CYCLE

Symbol	Parameter	Limits				Units
		-55H, -55HI		-70H, -70HI		
		Min	Max	Min	Max	
t _{CR}	Read cycle time	55		70		ns
t _a (A)	Address access time		55		70	ns
t _a (S)	Chip select access time		55		70	ns
t _a (OE)	Output enable access time		25		35	ns
t _{dis} (S)	Output disable time after S# high		20		25	ns
t _{dis} (OE)	Output disable time after OE# high		20		25	ns
t _{en} (S)	Output enable time after S# low	10		10		ns
t _{en} (OE)	Output enable time after OE# low	5		5		ns
t _v (A)	Data valid time after address	10		10		ns

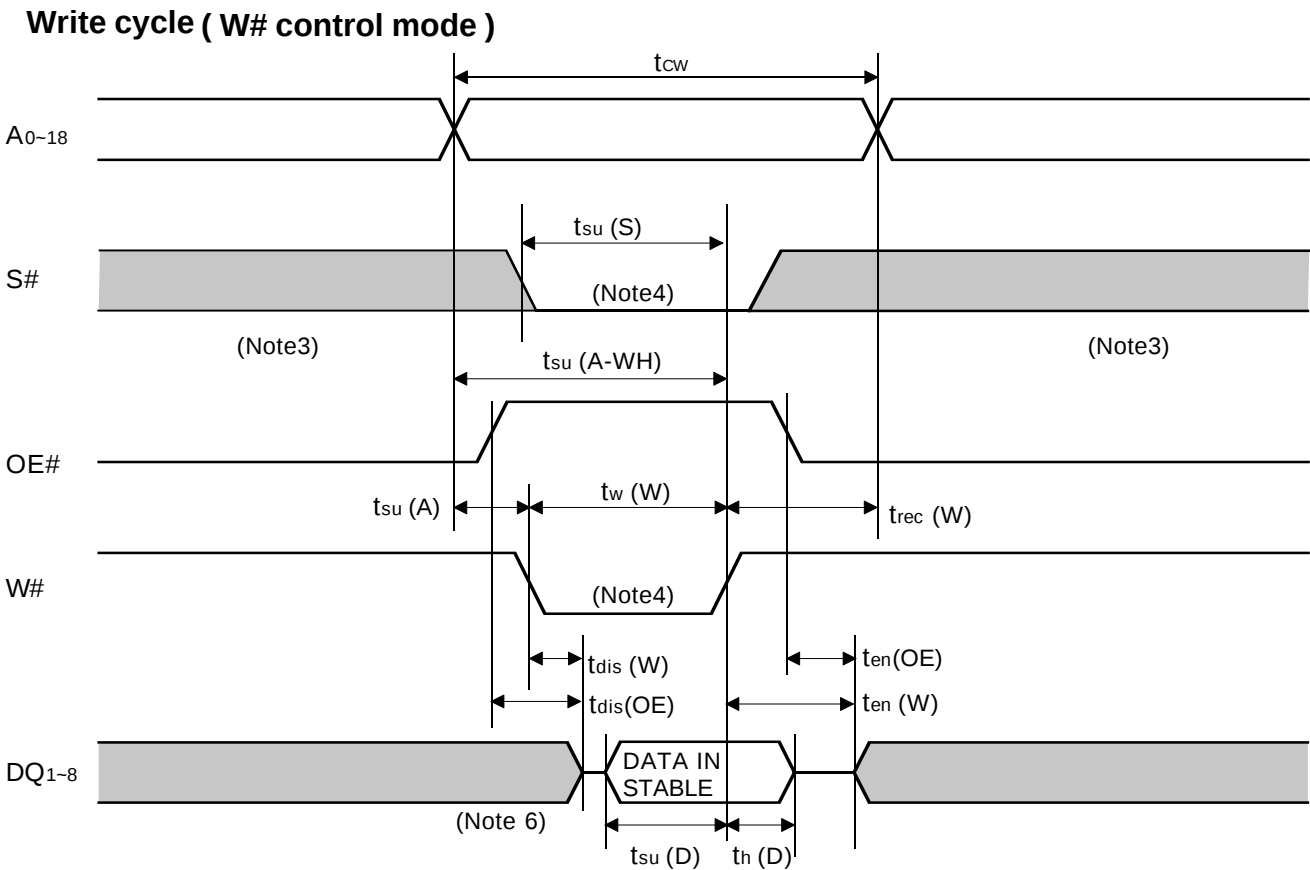
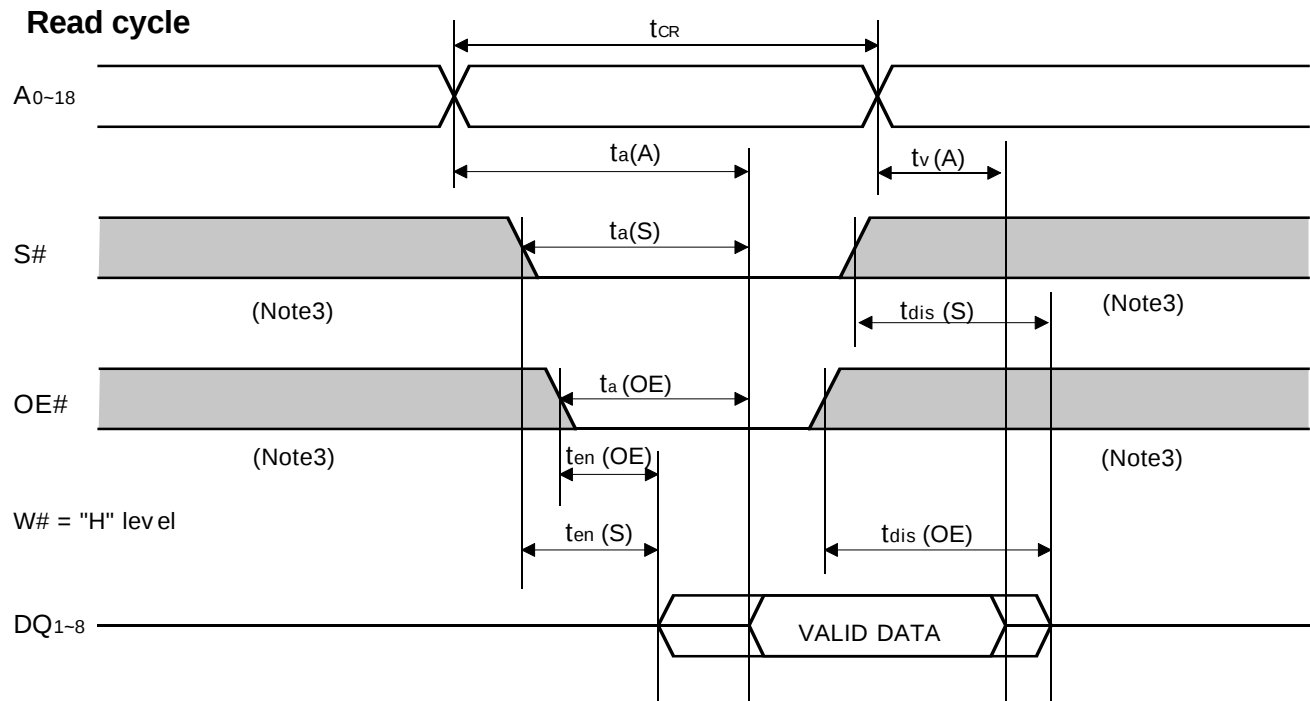
(3) WRITE CYCLE

Symbol	Parameter	Limits				Units
		-55H, -55HI		-70H, -70HI		
		Min	Max	Min	Max	
t _{cw}	Write cycle time	55		70		ns
t _{w(W)}	Write pulse width	40		50		ns
t _{su(A)}	Address set up time	0		0		ns
t _{su(A-WH)}	Address set up time with respect to W# high	50		60		ns
t _{su(S)}	Chip select set up time	50		60		ns
t _{su(D)}	Data set up time	25		30		ns
t _{h(D)}	Data hold time	0		0		ns
t _{rec(W)}	Write recovery time	0		0		ns
t _{dis(W)}	Output disable time after W# low		20		25	ns
t _{dis(OE)}	Output disable time after OE# high		20		25	ns
t _{en(W)}	Output enable time after W# high	5		5		ns
t _{en(OE)}	Output enable time after OE# low	5		5		ns

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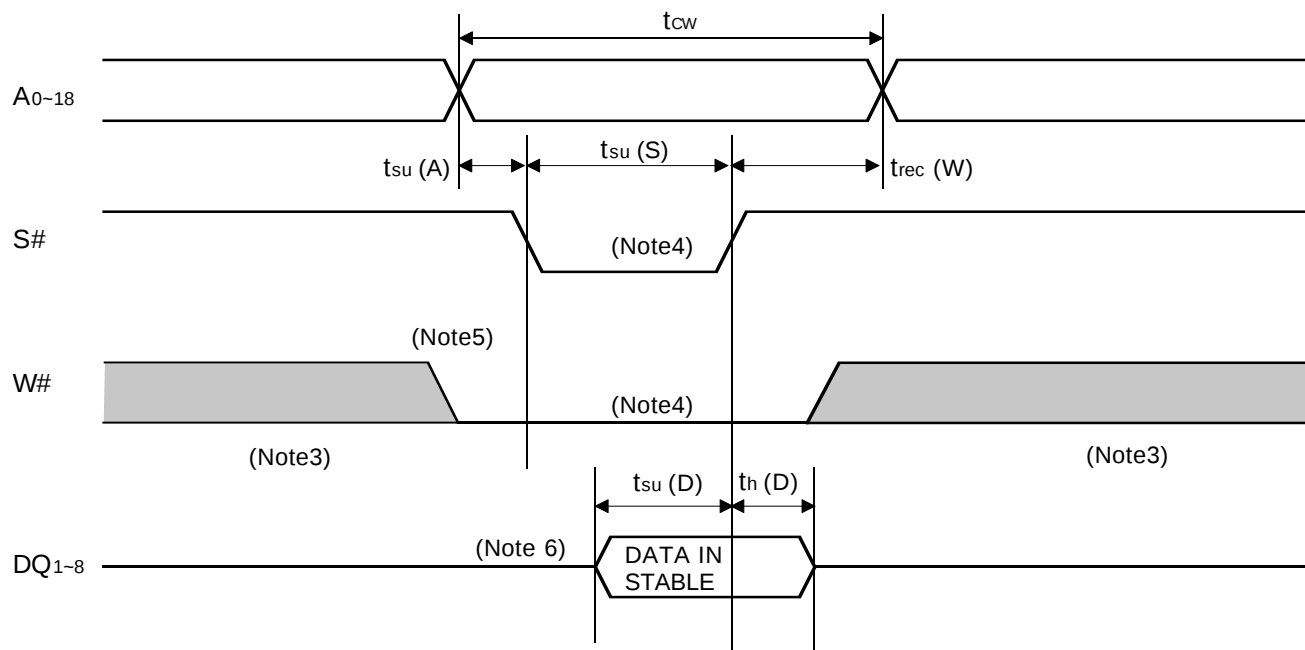
(4)TIMING DIAGRAMS



M5M5408BFP/TP/RT

4194304-BIT (524288-WORD BY 8-BIT) CMOS STATIC RAM

Write cycle (S# control mode)



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

Note 4: A Write occurs during the overlap of a low S# and a low W#.

Note 5: If W goes low simultaneously with or prior to S#, the output remains in the high impedance state.

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

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POWER DOWN CHARACTERISTICS

(1) ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions			Limits			Units
					Min	Typical	Max	
V _{CC} (PD)	Power down supply voltage				2	-	-	V
V _I (S#)	Chip select input S#	V _{CC} (PD) ≥ 2.2V			2.2	-	-	
		2.2V ≥ V _{CC} (PD) ≥ 2.0V			-	V _{CC} (PD)	-	
I _{CC} (PD)	Power down supply current	V _{CC} =3.0V, S# ≥ V _{CC} -0.2V, Other input =0 ~ V _{CC}	I-version	85°C	-	-	30	μA
			Standard,	70°C	-	-	15	
			I-version	40°C	-	1*	3	
			Standard	0~ 25°C	-	0.4*	1	
			I-version	-40~ 25°C	-	0.4*	1	

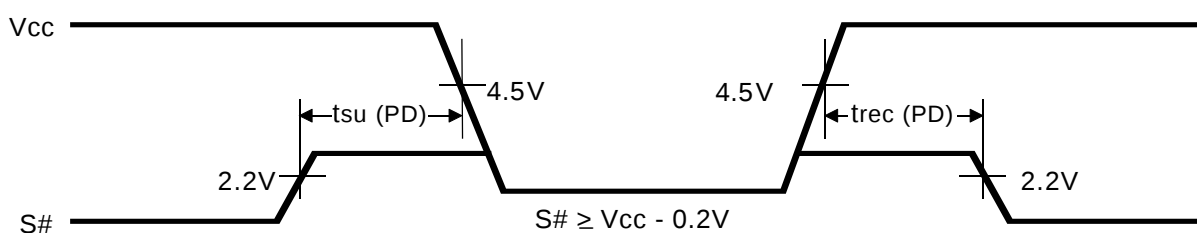
*Typical values are sampled, and are not 100% tested.

(2) TIMING REQUIREMENTS

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

(3) TIMING DIAGRAM

S# control mode



M5M5408BFP/TP/RT

4194304-BIT (524288-WORD BY 8-BIT) CMOS STATIC RAM

Revision History

<u>Revision No.</u>	<u>History</u>	<u>Date</u>	
K0.1e	The first edition	Jul.30, '98	Preliminary
K0.2e	1) lcc3 limit revised 2) lcc(PD) limit revised 3) lcc1,lcc2 conditions revised	Jun. 3, '99	Preliminary
K0.3e	1) Vcc Level in the Block Diagram revised 2) lcc3 limit (typ) revised	Jun.28, '99	Preliminary
K1.0e	The first product version	Oct.12, '99	---
K1.1e	Product lineup revised	Oct.21, '99	---
2.0e	1) Product lineup revised 2) Symbol notations revised: $\bar{S}$ -> S#, $\bar{W}$ -> W#, $\overline{OE}$ -> OE# 3) lcc(PD) conditions revised	Feb.12, '02	---

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