

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 and 32-pin plastic TSOP packages. Two types of TSOPs are available, M5M5408BTP (normal-lead-bend TSOP) and 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 three versions; "Standard", "W-version", and "I-version". Those are summarized in the part name table below.

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 \overline{S}
- 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:
 - 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", "RT")	Power Supply	Access time max.	Stand-by current I _{cc} (PD), V _{cc} =3.0V			Active current I _{cc} 1 (5.0V, typ.)
				typical *	Ratings (max.)		
				25°C	70°C	85°C	
Standard 0 ~ +70°C	M5M5408B## -55L	5.0V	55ns	---	50μA	---	50mA (10MHz) 25mA (1MHz)
	M5M5408B## -70L		70ns				
	M5M5408B## -55H	5.0V	55ns	0.4μA	15μA	---	
	M5M5408B## -70H		70ns				
W-version -20 ~ +85°C	M5M5408B## -55LW	5.0V	55ns	---	---	100μA	
	M5M5408B## -70LW		70ns				
	M5M5408B## -55HW	5.0V	55ns	0.4μA	---	30μA	
	M5M5408B## -70HW		70ns				
I-version -40 ~ +85°C	M5M5408B## -55LI	5.0V	55ns	---	---	100μA	
	M5M5408B## -70LI		70ns				
	M5M5408B## -55HI	5.0V	55ns	0.4μA	---	30μA	
	M5M5408B## -70HI		70ns				

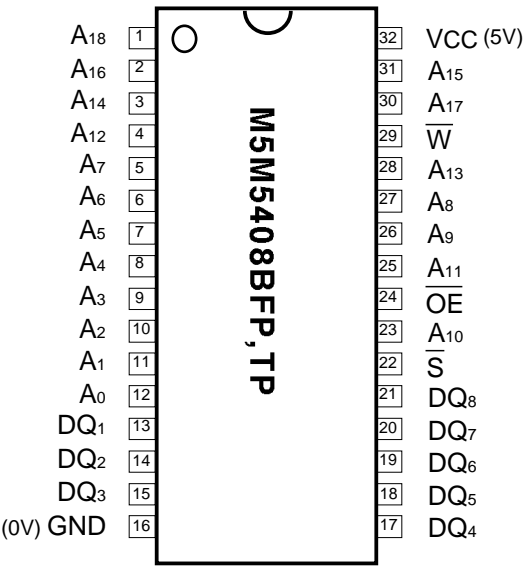
* "typical" parameter is sampled, not 100% tested.



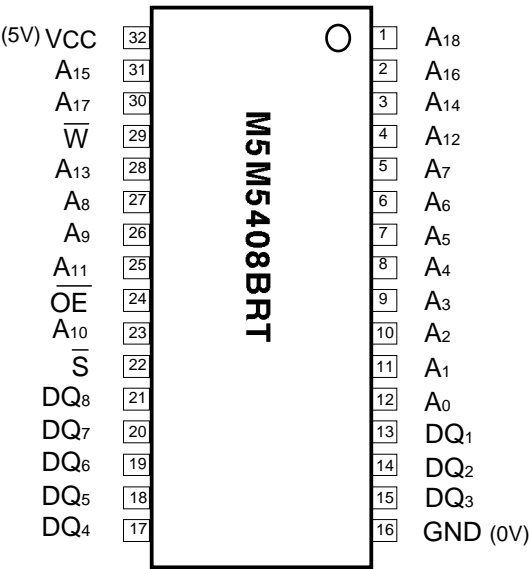
M5M5408BFP/TP/RT

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

PIN CONFIGURATION (TOP VIEW)



Outline
 32P2M-A (FP)
 32P3Y-H (TP)



Outline
 32P3Y-J (RT)

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 \overline{S} low and \overline{W} low overlap time. The address(A0~A18) must be set up before the write cycle

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

When setting \overline{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.

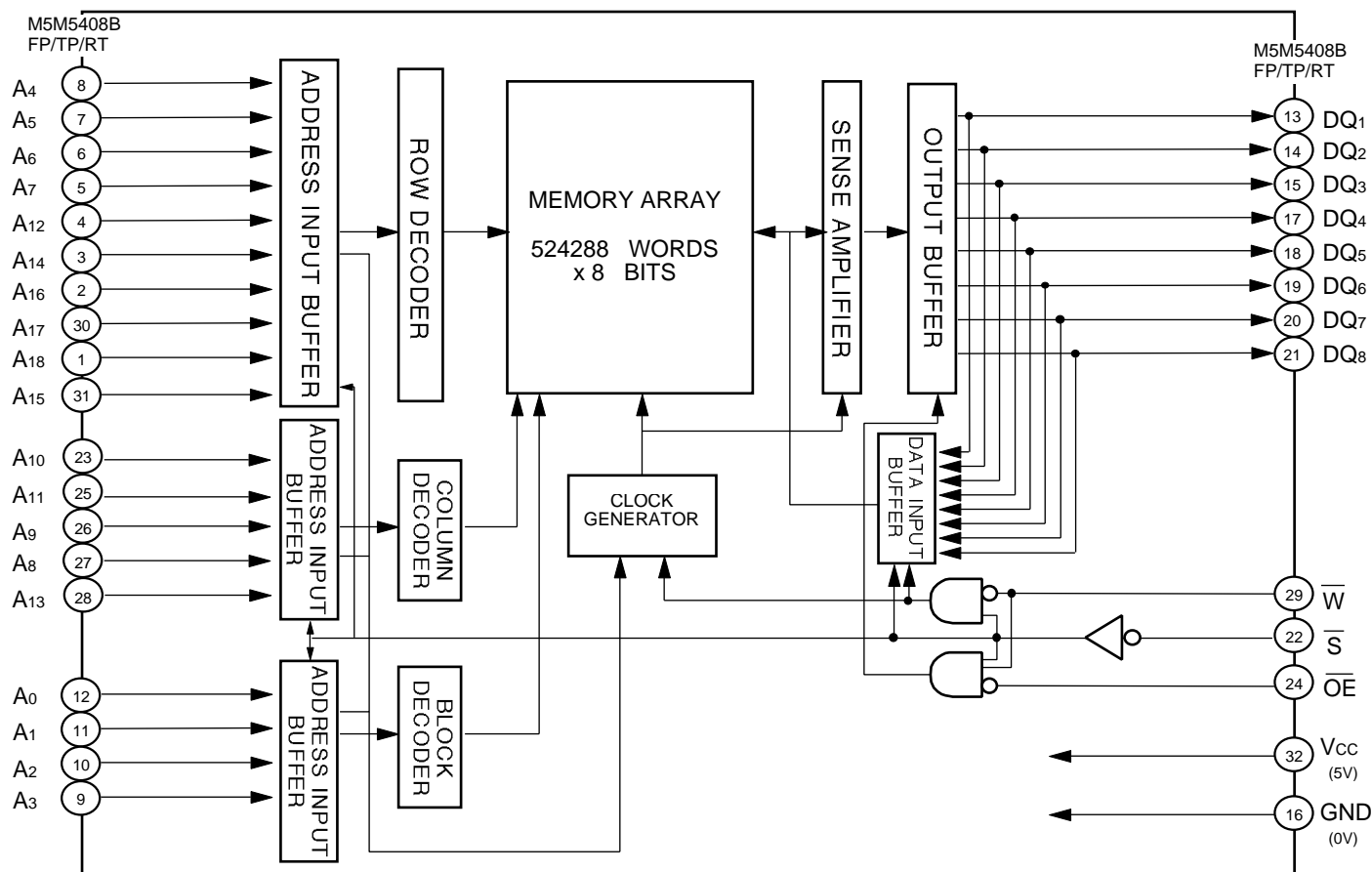
The power supply current is reduced as low as 0.4μA(25°C, typical), and the memory data can be held at +2V power supply, enabling battery back-up operation during power failure or power-down operation in the non-selected mode.

FUNCTION TABLE

$\overline{\text{S}}$	$\overline{\text{W}}$	$\overline{\text{OE}}$	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

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

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 (-L, -H)	0 ~ +70	°C
		W-version (-LW, -HW)	-20 ~ +85	
		I-version (-LI, -HI)	-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	\overline{S} =V _{IH} or \overline{OE} =V _{IH} , V _{I/O} =0 ~ V _{CC}				±1	
I _{CC1}	Active supply current (AC,MOS level)	\overline{S} ≤0.2V Output-open Other inputs ≤0.2V or ≥V _{CC} -0.2V	f= 10MHz	-	50	80	mA
			f= 1MHz	-	25	30	
I _{CC2}	Active supply current (AC,TTL level)	\overline{S} =V _{IL} Output-open Other inputs=V _{IH} or V _{IL}	f= 10MHz	-	60	90	
			f= 1MHz	-	30	40	
I _{CC3}	Stand by supply current (AC,MOS level)	\overline{S} ≥V _{CC} -0.2V Other inputs=0~V _{CC}	-LW, -LI	-	-	200	μA
			-L	-	-	100	
			-HW, -HI	-	1.0	60	
			-H	-	1.0	30	
I _{CC4}	Stand by supply current (AC,TTL level)	\overline{S} =V ,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 ≤ 50ns)

Note 2: Typical value is for V_{CC}=5.0V and T_a=25°C**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 ($V_{CC}=5.0V\pm 10\%$, unless otherwise noted)

(1) TEST CONDITIONS

Supply voltage	5.0V
Input pulse	$V_{IH}=2.4V, V_{IL}=0.6V$ (FP,TP,RT-70) $V_{IH}=3.0V, V_{IL}=0V$ (FP,TP,RT-55)
Input rise time and fall time	5ns
Reference level	$V_{OH}=V_{OL}=1.5V$ Transition is measured $\pm 500mV$ from steady state voltage. (for t_{en}, t_{dis})
Output loads	Fig.1, $CL=100pF$ (FP,TP,RT-70) $CL=30pF$ (FP,TP,RT-55) $CL=5pF$ (for t_{en}, t_{dis})

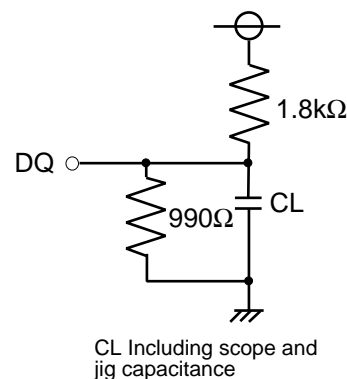


Fig.1 Output load

(2) READ CYCLE

Symbol	Parameter	Limits				Units
		M5M5408BFP,TP,RT-55		M5M5408BFP,TP,RT-70		
		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 \overline{S} high		20		25	ns
t _{dis} (OE)	Output disable time after \overline{OE} high		20		25	ns
t _{en} (S)	Output enable time after \overline{S} low	10		10		ns
t _{en} (OE)	Output enable time after \overline{OE} low	5		5		ns
t _v (A)	Data valid time after address	10		10		ns

(3) WRITE CYCLE

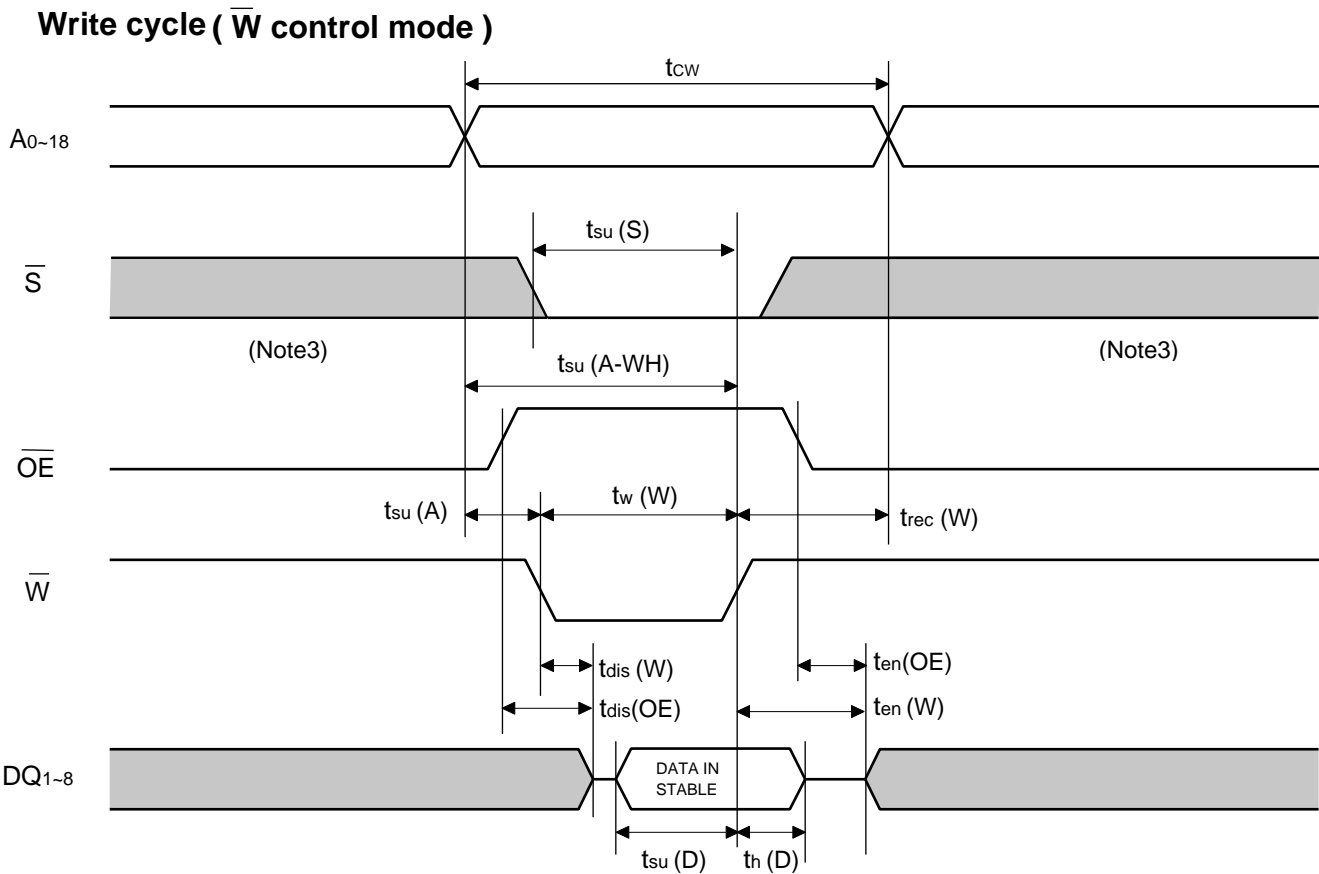
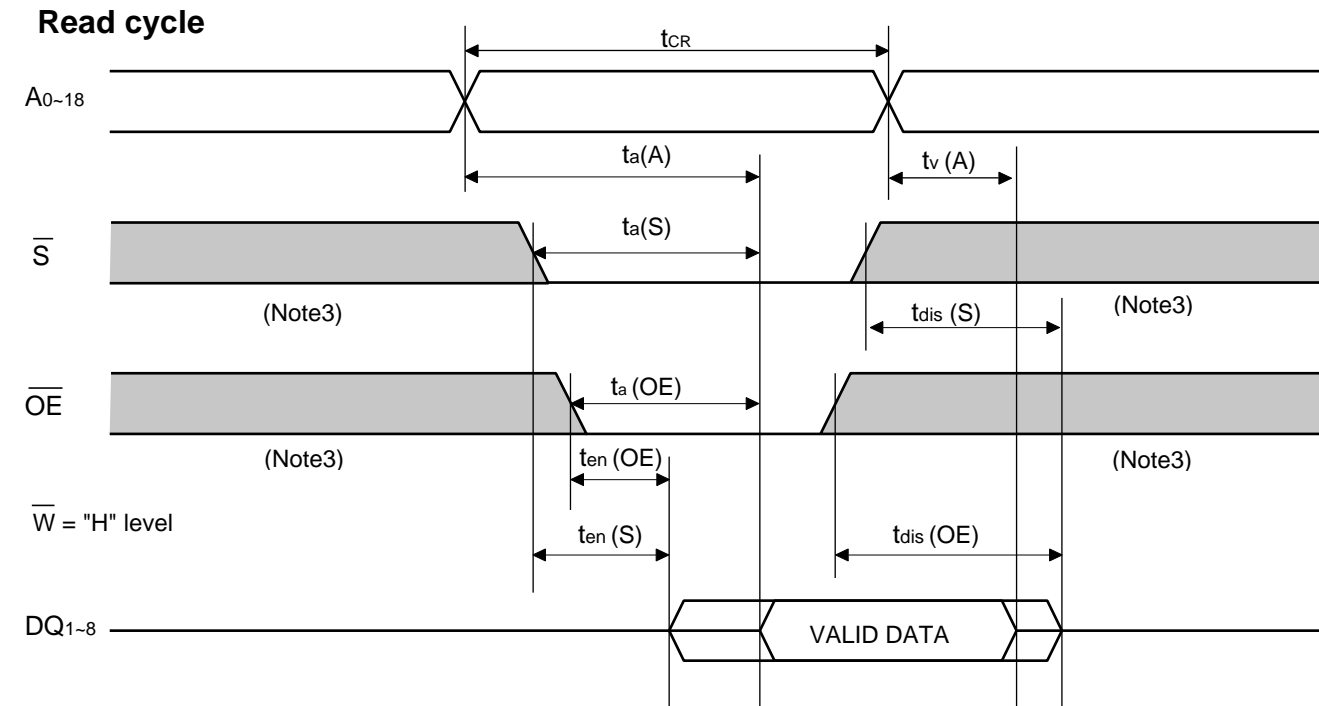
Symbol	Parameter	Limits				Units
		M5M5408BFP,TP,RT-55		M5M5408BFP,TP,RT-70		
		Min	Max	Min	Max	
t _{cw}	Write cycle time	55		70		ns
t _w (W)	Write pulse width	40		50		ns
t _{su} (A)	Address set up time	0		0		ns
t _{su} (A-WH)	Address set up time with respect to \overline{W} high	50		60		ns
t _{su} (S)	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 \overline{W} low		20		25	ns
t _{dis} (OE)	Output disable time after \overline{OE} high		20		25	ns
t _{en} (W)	Output enable time after \overline{W} high	5		5		ns
t _{en} (OE)	Output enable time after \overline{OE} low	5		5		ns



M5M5408BFP/TP/RT

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

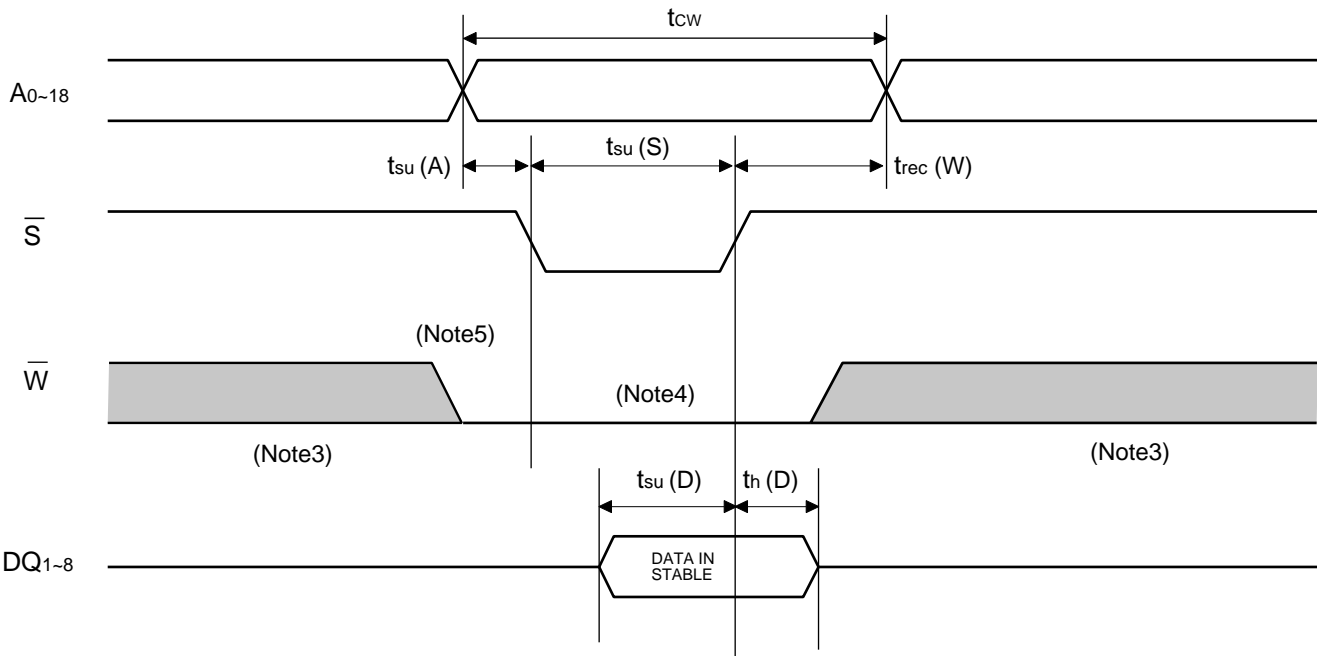
(4)TIMING DIAGRAMS



M5M5408BFP/TP/RT

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

Write cycle (\overline{S} control mode)



- Note 3: Hatching indicates the state is "don't care".
- Note 4: A Write occurs during the overlap of a low \overline{S} and a low \overline{W} .
- Note 5: If \overline{W} goes low simultaneously with or prior to \overline{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.

M5M5408BFP/TP/RT

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

POWER DOWN CHARACTERISTICS

(1) ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions		Limits			Units
				Min	Typ.	Max	
Vcc (PD)	Power down supply voltage			2	-	-	V
Vi (\overline{S})	Chip select input \overline{S}	Vcc(PD) \geq 2.2V		2.2	-	-	V
		2.2V \geq Vcc(PD) \geq 2.0V		-	Vcc(PD)	-	V
Icc (PD)	Power down supply current	Vcc=3.0V, $\overline{S}\geq$ Vcc-0.2V, Other inputs=0 ~ Vcc	-LW, -LI	-	-	100	μ A
			-L	-	-	50	μ A
			-HW, -HI	-	0.4	30	μ A
			-H	-	0.4	15	μ A

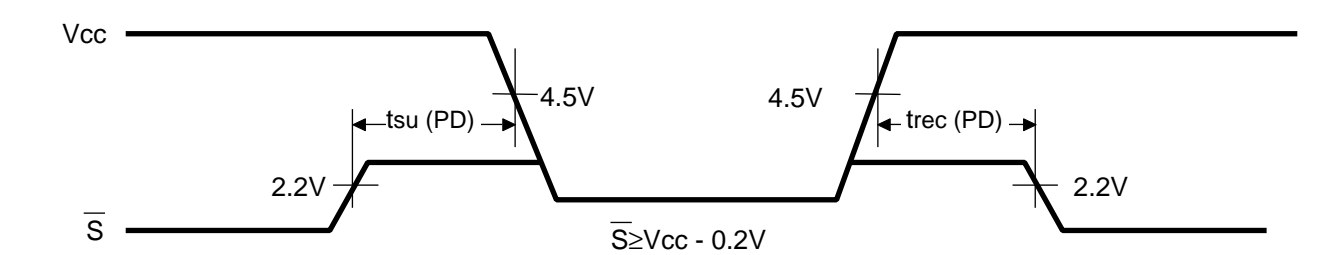
Typical value is for Ta=25°C

(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

\overline{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	'98.7.30	Preliminary
K0.2e	1) lcc3 limit revised	'99.6.3	Preliminary
	2) lcc(PD) limit revised	'98.6.3	Preliminary
	3) lcc1,lcc2 conditions revised	'98.6.3	Preliminary
K0.3e	1) Vcc Level in the Block Diagram revised	'99.6.28	Preliminary
	2) lcc3 limit (typ) revised	'99.6.28	Preliminary
K1.0e	The first product version	'99.10.12	---
K1.1e	Product Lineup Revised	'99.10.21	---



Keep safety first in your circuit designs!

Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

These materials are intended as a reference to assist our customers in the selection of the Mitsubishi semiconductor product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Mitsubishi Electric Corporation or a third party.

Mitsubishi Electric Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.

All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for the latest product information before purchasing a product listed herein.

The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.

Please also pay attention to information published by Mitsubishi Electric Corporation by various means, including the Mitsubishi Semiconductor home page (<http://www.mitsubishichips.com>).

When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.

Mitsubishi Electric Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.

The prior written approval of Mitsubishi Electric Corporation is necessary to reprint or reproduce in whole or in part these materials.

If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.

Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.

Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for further details on these materials or the products contained therein.