

**DESCRIPTION**

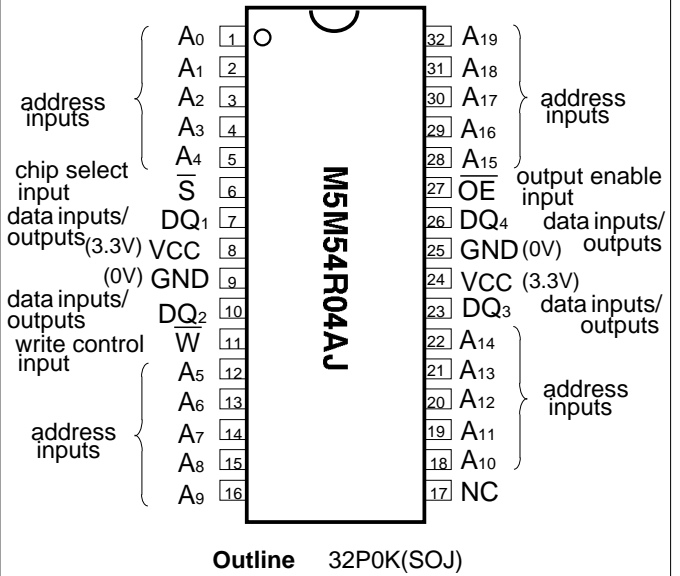
The M5M54R04AJ is a family of 1048576-word by 4-bit static RAMs, fabricated with the high performance CMOS silicon gate process and designed for high speed application.

These devices operate on a single 3.3V supply, and are directly TTL compatible. They include a power down feature as well.

**FEATURES**

- Fast access time M5M54R04AJ-10 ... 10ns(max)  
M5M54R04AJ-12 ... 12ns(max)  
M5M54R04AJ-15 ... 15ns(max)
- Single +3.3V power supply
- Fully static operation : No clocks, No refresh
- Common data I/O
- Easy memory expansion by S
- Three-state outputs : OR-tie capability
- OE prevents data contention in the I/O bus
- Directly TTL compatible : All inputs and outputs

**PIN CONFIGURATION (TOP VIEW)**



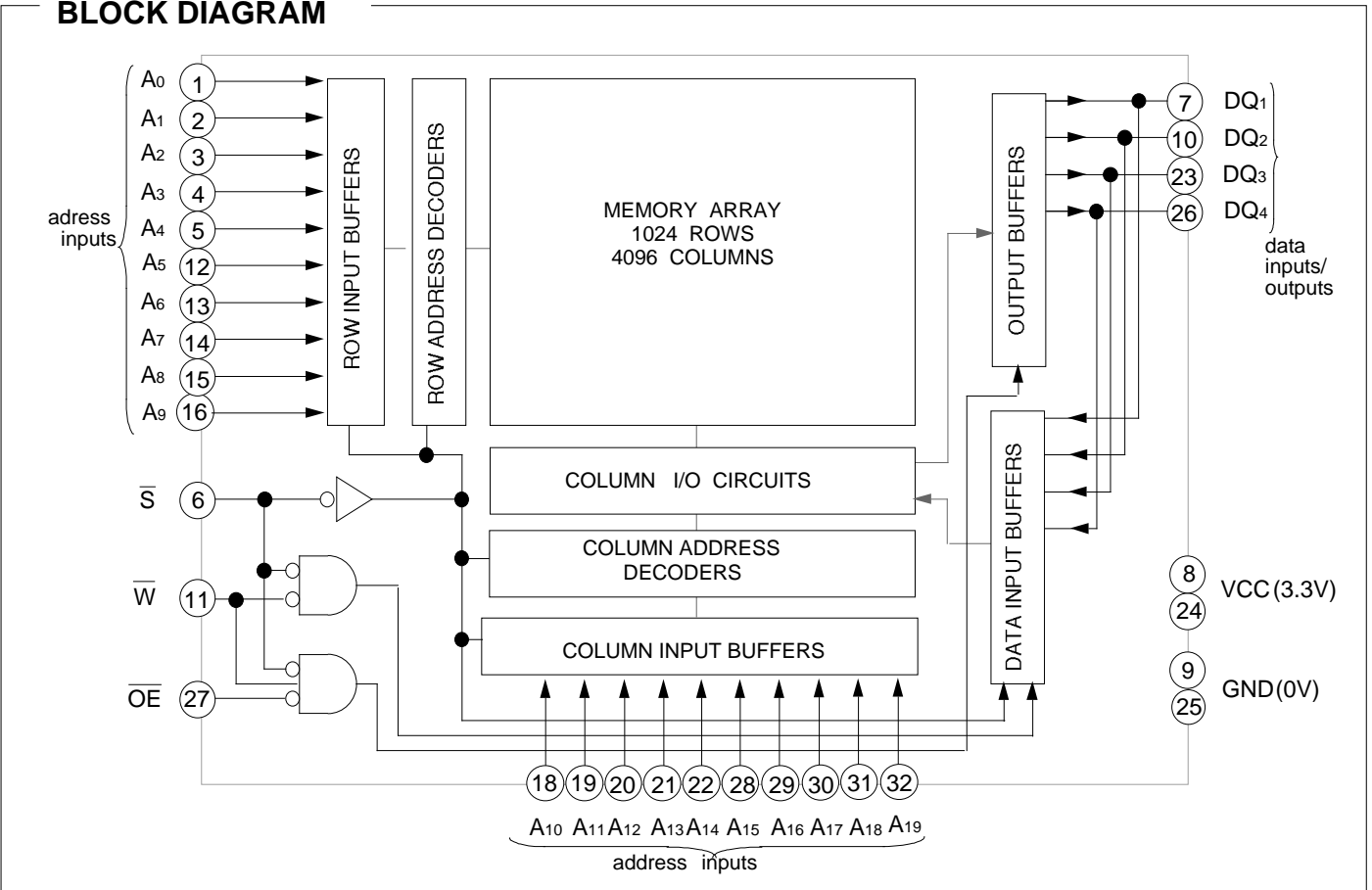
**APPLICATION**

High-speed memory units

**PACKAGE**

M5M54R04AJ : 32pin 400mil SOJ

**BLOCK DIAGRAM**



## FUNCTION

The operation mode of the M5M54R04AJ is determined by a combination of the device control inputs  $\bar{S}$ ,  $\bar{W}$  and  $\bar{OE}$ . Each mode is summarized in the function table.

A write cycle is executed whenever the low level  $\bar{W}$  overlaps with the low level  $\bar{S}$ . 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  $\bar{W}$  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  $\bar{S}$  are in an active state ( $\bar{S}=L$ ).

When setting  $\bar{S}$  at high level, the chip is 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  $\bar{S}$ .

Signal  $\bar{S}$  controls the power-down feature. When  $\bar{S}$  goes high, power dissipation is reduced extremely. The access time from  $\bar{S}$  is equivalent to the address access time.

## FUNCTION TABLE

$\bar{S}$	$\bar{W}$	$\bar{OE}$	Mode	DQ	I <sub>cc</sub>
H	X	X	Non selection	High-impedance	Stand by
L	L	X	Write	Din	Active
L	H	L	Read	Dout	Active
L	H	H		High-impedance	Active

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
V <sub>cc</sub>	Supply voltage	With respect to GND	- 2.0* ~ 4.6	V
V <sub>I</sub>	Input voltage		- 2.0* ~ V <sub>CC</sub> +0.5	V
V <sub>O</sub>	Output voltage		- 2.0* ~ V <sub>CC</sub>	V
P <sub>d</sub>	Power dissipation	T <sub>a</sub> =25°C	1000	mW
T <sub>opr</sub>	Operating temperature		0 ~ 70	°C
T <sub>stg(bias)</sub>	Storage temperature(bias)		- 10 ~ 85	°C
T <sub>stg</sub>	Storage temperature		- 65 ~ 150	°C

\* Pulse width\_3ns, In case of DC: - 0.5V

## DC ELECTRICAL CHARACTERISTICS (T<sub>a</sub>=0 ~ 70°C, V<sub>cc</sub>=3.3V<sup>+10%</sup><sub>-5%</sub>, unless otherwise noted)

Symbol	Parameter	Condition	Limits			Unit	
			Min	Typ	Max		
V <sub>IH</sub>	High-level input voltage		2.0		V <sub>cc</sub> +0.3	V	
V <sub>IL</sub>	Low-level input voltage				0.8	V	
V <sub>OH</sub>	High-level output voltage	I <sub>OH</sub> = - 4mA	2.4			V	
V <sub>OL</sub>	Low-level output voltage	I <sub>OL</sub> = 8mA			0.4	V	
I <sub>I</sub>	Input current	V <sub>I</sub> = 0 ~ V <sub>cc</sub>			2	uA	
I <sub>OZ</sub>	Output current in off-state	V <sub>I</sub> ( $\bar{S}$ )=V <sub>IH</sub> V <sub>I</sub> ( $\bar{O}$ )= 0 ~ V <sub>cc</sub>			2	uA	
I <sub>CC1</sub>	Active supply current (TTL level)	V <sub>I</sub> ( $\bar{S}$ )=V <sub>IL</sub> other inpus=V <sub>IH</sub> or V <sub>IL</sub> Output-open(duty 100%)	AC	10ns cycle		190	mA
				12ns cycle		180	
			15ns cycle		160		
			DC		90		
I <sub>CC2</sub>	Stand by current (TTL level)	V <sub>I</sub> ( $\bar{S}$ )=V <sub>IH</sub>	AC	10ns cycle		90	mA
				12ns cycle		70	
			15ns cycle		60		
			DC		40		
I <sub>CC3</sub>	Stand by current	V <sub>I</sub> ( $\bar{S}$ )=V <sub>cc</sub> _0.2V other inputs V <sub>I</sub> _0.2V or V <sub>I</sub> _V <sub>cc</sub> - 0.2V			10	mA	

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

**CAPACITANCE** ( $T_a=0\sim 70^\circ\text{C}$ ,  $V_{cc}=3.3\text{V}^{+10\%}_{-5\%}$ , unless otherwise noted)

Symbol	Parameter	Test Condition	Limit			Unit
			Min	Typ	Max	
C <sub>i</sub>	Input capacitance	$V_I = \text{GND}, V_I = 25\text{mVrms}, f=1\text{MHz}$			7	pF
C <sub>o</sub>	Output capacitance	$V_O = \text{GND}, V_O = 25\text{mVrms}, f=1\text{MHz}$			8	pF

Note 2: C<sub>i</sub>, C<sub>o</sub> are periodically sampled and are not 100% tested.

**AC ELECTRICAL CHARACTERISTICS** ( $T_a=0\sim 70^\circ\text{C}$ ,  $V_{cc}=3.3\text{V}^{+10\%}_{-5\%}$ , unless otherwise noted)

**(1) MEASUREMENT CONDITION**

- Input pulse levels .....  $V_{IH}=3.0\text{V}, V_{IL}=0.0\text{V}$
- Input rise and fall time ..... 3ns
- Input timing reference levels .....  $V_{IH}=1.5\text{V}, V_{IL}=1.5\text{V}$
- Output timing reference levels .....  $V_{OH}=1.5\text{V}, V_{OL}=1.5\text{V}$
- Output loads ..... Fig.1, Fig.2

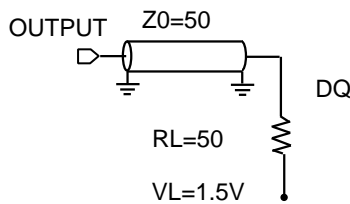


Fig.1 Output load

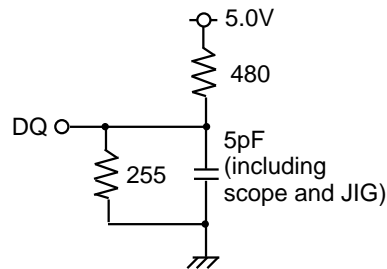


Fig.2 Output load for  $t_{en}, t_{dis}$

**MITSUBISHI LSIs**  
**M5M54R04AJ-10,-12,-15**

**4194304-BIT (1048576-WORD BY 4-BIT) CMOS STATIC RAM**

**(2)READ CYCLE**

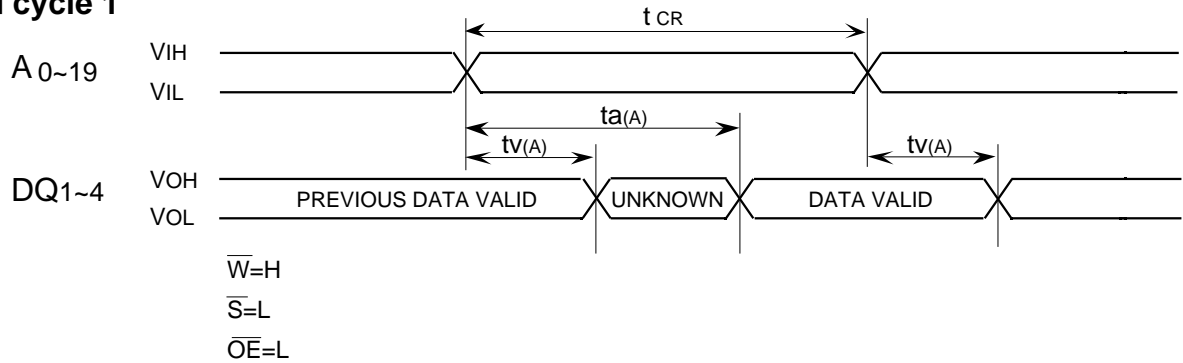
Symbol	Parameter	Limits						Unit
		M5M54R04AJ-10		M5M54R04AJ-12		M5M54R04AJ-15		
		Min	Max	Min	Max	Min	Max	
t <sub>CR</sub>	Read cycle time	10		12		15		ns
t <sub>a(A)</sub>	Address access time		10		12		15	ns
t <sub>a(S)</sub>	Chip select access time		10		12		15	ns
t <sub>a(OE)</sub>	Output enable access time		5		6		7	ns
t <sub>dis(S)</sub>	Output disable time after $\overline{S}$ high	0	5	0	6	0	7	ns
t <sub>dis(OE)</sub>	Output disable time after $\overline{OE}$ high	0	5	0	6	0	7	ns
t <sub>en(S)</sub>	Output enable time after $\overline{S}$ low	2		3		3		ns
t <sub>en(OE)</sub>	Output enable time after $\overline{OE}$ low	0		1		1		ns
t <sub>v(A)</sub>	Data valid time after address change	2		3		3		ns
t <sub>PU</sub>	Power-up time after chip selection	0		0		0		ns
t <sub>PD</sub>	Power-down time after chip selection		10		12		15	ns

**(3)WRITE CYCLE**

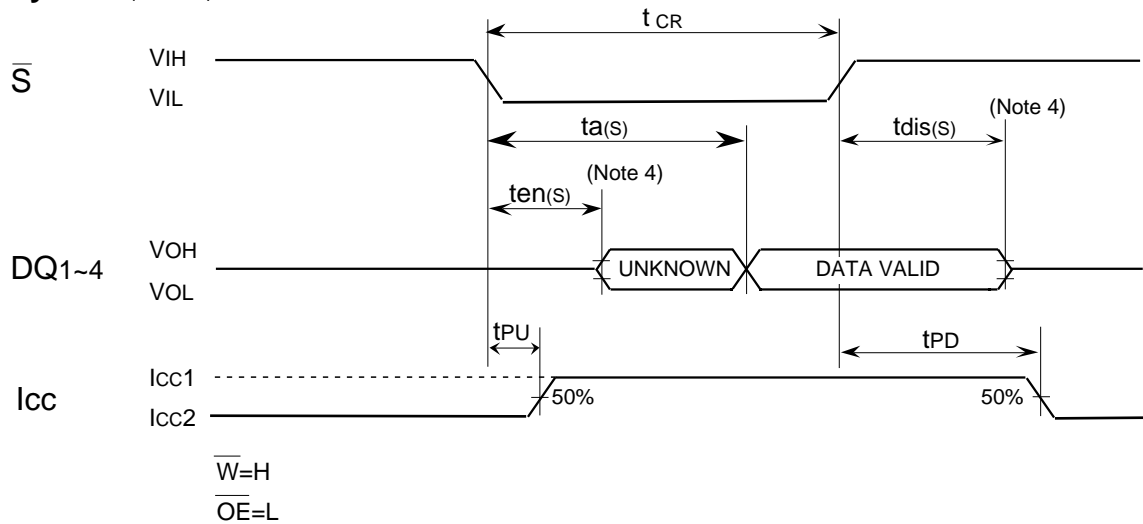
Symbol	Parameter	Limits						Unit
		M5M54R04AJ-10		M5M54R04AJ-12		M5M54R04AJ-15		
		Min	Max	Min	Max	Min	Max	
t <sub>cw</sub>	Write cycle time	10		12		15		ns
t <sub>w(W)</sub>	Write pulse width ( $\overline{OE}$ low)	10		12		15		ns
t <sub>w(W)</sub>	Write pulse width ( $\overline{OE}$ high)	8		10		10		ns
t <sub>su(A)1</sub>	Address setup time( $\overline{W}$ )	0		0		0		ns
t <sub>su(A)2</sub>	Address setup time( $\overline{S}$ )	0		0		0		ns
t <sub>su(S)</sub>	Chip select setup time	8		10		10		ns
t <sub>su(D)</sub>	Data setup time	5		6		7		ns
t <sub>h(D)</sub>	Data hold time	0		0		0		ns
t <sub>rec(W)</sub>	Write recovery time	1		1		1		ns
t <sub>dis(W)</sub>	Output disable time after $\overline{W}$ low	0	5	0	6	0	7	ns
t <sub>dis(OE)</sub>	Output disable time after $\overline{OE}$ high	0	5	0	6	0	7	ns
t <sub>en(W)</sub>	Output enable time after $\overline{W}$ high	0		0		0		ns
t <sub>en(OE)</sub>	Output enable time after $\overline{OE}$ low	0		0		0		ns
t <sub>su(A-<math>\overline{W}</math>)</sub>	Address to $\overline{W}$ High	8		10		10		ns

**(4)TIMING DIAGRAMS**

**Read cycle 1**



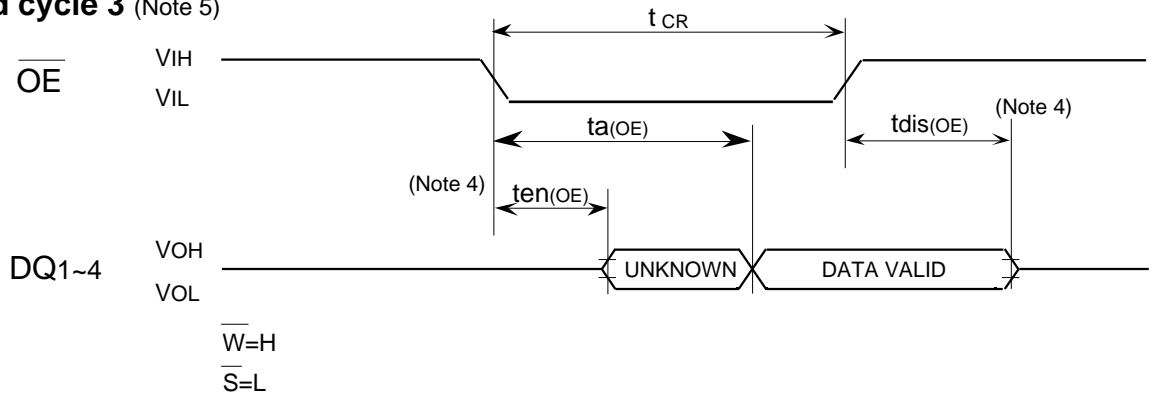
**Read cycle 2 (Note 3)**



Note 3. Addresses valid prior to or coincident with  $\bar{S}$  transition low.

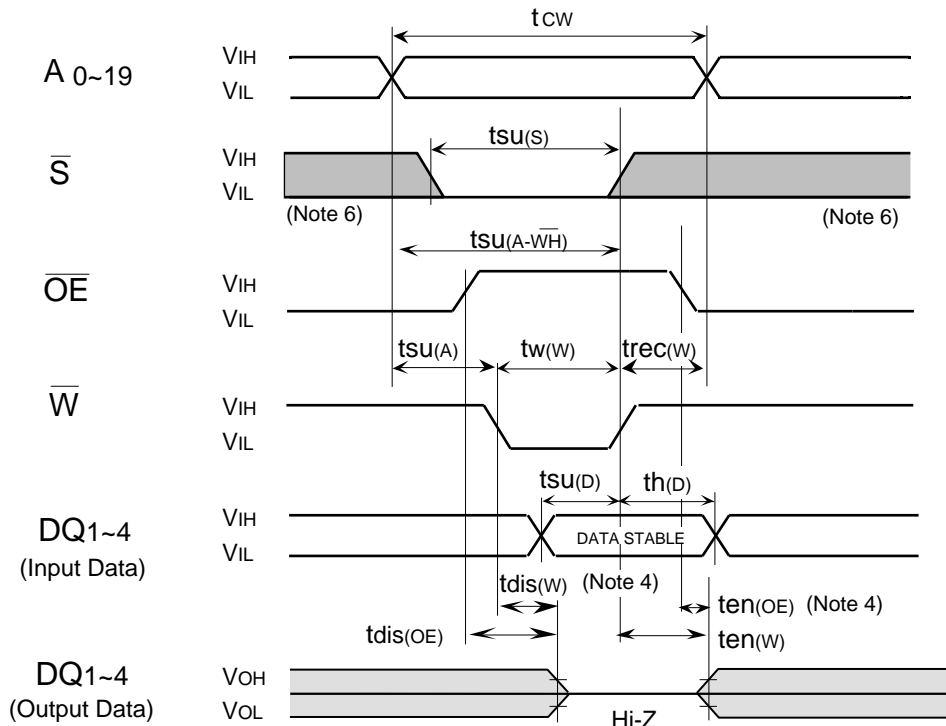
4. Transition is measured  $\pm 500\text{mv}$  from steady state voltage with specified loading in Figure 2.

**Read cycle 3 (Note 5)**

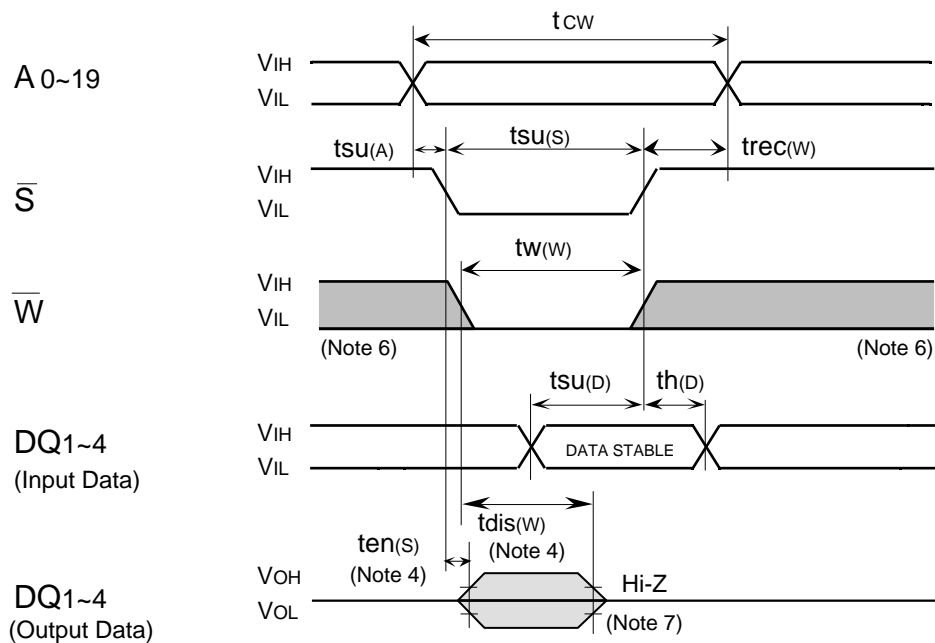


Note 5. Addresses and  $\bar{S}$  valid prior to  $\bar{OE}$  transition low by  $(ta(A)-ta(OE))$ ,  $(ta(S)-ta(OE))$

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



**Write cycle ( $\overline{S}$  control)**



Note 6: Hatching indicates the state is don't care.

7: When the falling edge of  $\overline{W}$  is simultaneous or prior to the falling edge of  $\overline{S}$ , the output is maintained in the high impedance.

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