

HM514258A Series

262,144-Word X 4-Bit CMOS Dynamic RAM

DESCRIPTION

The Hitachi HM514258A is a CMOS dynamic RAM organized 262144-word x 4-bit. HM514258A has realized higher density, higher performance and various functions by employing 1.3 μ m CMOS technology and some new CMOS circuit design technologies. The HM514258A offers Static Column Mode as a high speed access mode.

Multiplexed address input permits the HM514258A to be packaged in standard 20-pin plastic DIP, 20-pin plastic SOJ and 20-pin plastic ZIP.

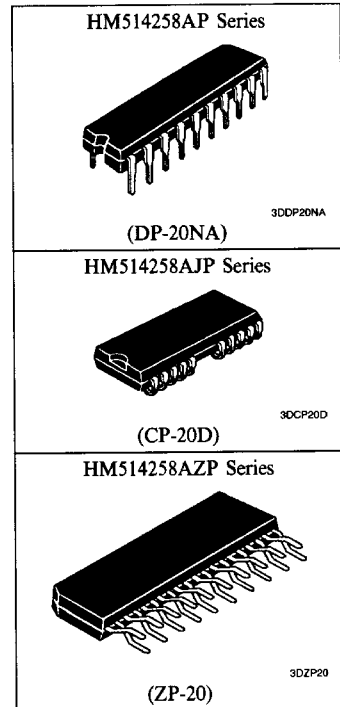
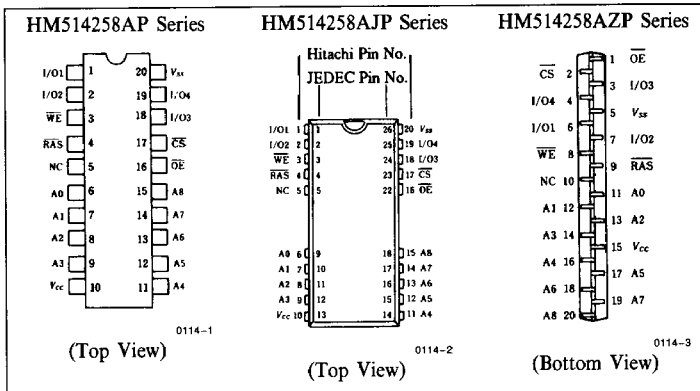
FEATURES

- Single 5V ($\pm 10\%$)
- High Speed
Access Time 60 ns/70 ns/80 ns/100 ns/120 ns (max)
- Low Power
Standby 11 mW (max)
Active 495 mW/440 mW/413 mW/358 mW/303 mW (max)
- Static Column Mode Capability
- 512 Refresh Cycles (8 ms)
- 2 Variations of Refresh
RAS Only Refresh
CS Before RAS Refresh

ORDERING INFORMATION

Part No.	Access Time	Package
HM514258AP-6	60 ns	300 mil 20-pin Plastic DIP (DP-20NA)
HM514258AP-7	70 ns	
HM514258AP-8	80 ns	
HM514258AP-10	100 ns	
HM514258AP-12	120 ns	
HM514258AJP-6	60 ns	300 mil 20-pin Plastic SOJ (CP-20D)
HM514258AJP-7	70 ns	
HM514258AJP-8	80 ns	
HM514258AJP-10	100 ns	
HM514258AJP-12	120 ns	
HM514258AZP-6	60 ns	400 mil 20-pin Plastic ZIP (ZP-20)
HM514258AZP-7	70 ns	
HM514258AZP-8	80 ns	
HM514258AZP-10	100 ns	
HM514258AZP-12	120 ns	

PIN OUT

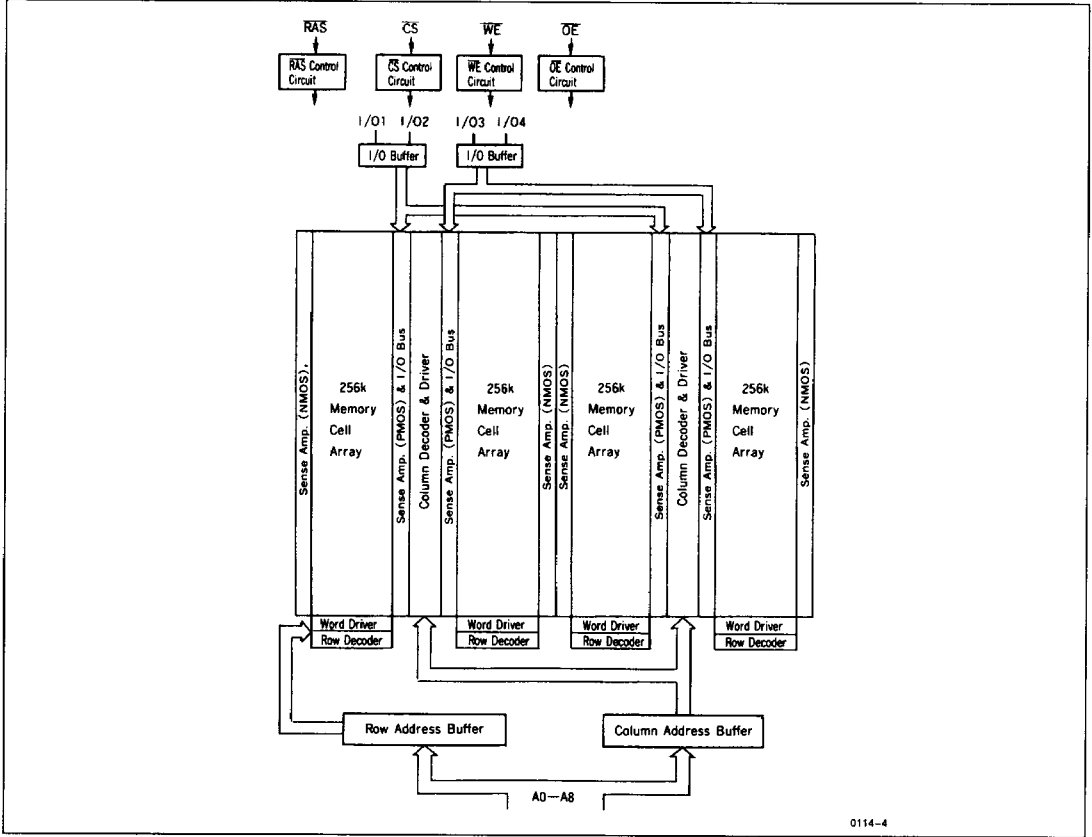


PIN DESCRIPTION

Pin Name	Function
A ₀ -A ₈	Address Input
A ₀ -A ₈	Refresh Address Input
I/O ₀ -I/O ₄	Data Input/Data Output
RAS	Row Address Strobe
CS	Chip Select
WE	Write Enable
OE	Output Enable
V _{CC}	Power Supply (+ 5V)
V _{SS}	Ground



■ BLOCK DIAGRAM



0114-4



■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Voltage on Any Pin Relative to V_{SS}	V_T	-1.0 to +7.0	V
Supply Voltage Relative to V_{SS}	V_{CC}	-1.0 to +7.0	V
Short Circuit Output Current	I_{out}	50	mA
Power Dissipation	P_T	1.0	W
Operating Temperature	T_{opr}	0 to +70	°C
Storage Temperature	T_{stg}	-55 to +125	°C

■ ELECTRICAL CHARACTERISTICS

• Recommended DC Operating Conditions ($T_A = 0$ to +70°C)

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply Voltage	V_{SS}	0	0	0	V	
	V_{CC}	4.5	5.0	5.5	V	1
Input High Voltage	V_{IH}	2.4	—	6.5	V	1
Input Low Voltage	I/O Pin	V_{IL}	—	0.8	V	1
	Others	V_{IL}	—	0.8	V	1

Note: 1. All voltage referenced to V_{SS} .

• DC Electrical Characteristics ($T_A = 0$ to +70°C, $V_{CC} = 5V \pm 10\%$, $V_{SS} = 0V$)

Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Test Conditions	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max			
Operating Current	I_{CC1}	—	90	—	80	—	75	—	65	—	55	mA	\overline{RAS} , \overline{CS} Cycling $t_{RC} = \text{Min}$	1, 2
Standby Current	I_{CC2}	—	2	—	2	—	2	—	2	—	2	mA	TTL Interface \overline{RAS} , $\overline{CS} = V_{IH}$, $D_{out} = \text{High-Z}$	
		—	1	—	1	—	1	—	1	—	1	mA	CMOS Interface, \overline{RAS} , $\overline{CS} \geq V_{CC} - 0.2V$, $D_{out} = \text{High-Z}$	
\overline{RAS} Only Refresh Current	I_{CC3}	—	90	—	80	—	75	—	65	—	55	mA	$t_{RC} = \text{Min}$	2
Standby Current	I_{CC5}	—	5	—	5	—	5	—	5	—	5	mA	$\overline{RAS} = V_{IH}$, $\overline{CS} = V_{IL}$, $D_{out} = \text{Enable}$	1
\overline{CS} Before \overline{RAS} Refresh Current	I_{CC6}	—	80	—	70	—	65	—	55	—	45	mA	$t_{RC} = \text{Min}$	
Static Column Mode Current	I_{CC9}	—	80	—	70	—	65	—	55	—	45	mA	$t_{SC} = \text{Min}$	1, 3
Input Leakage Current	I_{LI}	-10	10	-10	10	-10	10	-10	10	-10	10	μA	$0V \leq V_{in} \leq 7V$	
Output Leakage Current	I_{LO}	-10	10	-10	10	-10	10	-10	10	-10	10	μA	$0V \leq V_{out} \leq 7V$, $D_{out} = \text{Disable}$	
Output High Voltage	V_{OH}	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	V	High $I_{out} = -5$ mA	
Output Low Voltage	V_{OL}	0	0.4	0	0.4	0	0.4	0	0.4	0	0.4	V	Low $I_{out} = 4.2$ mA	

- Notes: 1. I_{CC} depends on output load condition when the device is selected. I_{CC} max is specified at the output open condition.
 2. Address can be changed less than three times while $\overline{RAS} = V_{IL}$.
 3. Address can be changed once or less while $\overline{CS} = V_{IH}$.



HM514258A Series

- **Capacitance** ($T_A = 25^\circ\text{C}$, $V_{CC} = 5V \pm 10\%$)

Parameter	Symbol	Typ	Max	Unit	Note
Input Capacitance (Address)	C_{I1}	—	5	pF	1
Input Capacitance (Clocks)	C_{I2}	—	7	pF	1
Input/Output Capacitance (Data Input, Data Output)	$C_{I/O}$	—	10	pF	1, 2

- Notes: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.
 2. $\overline{CS} = V_{IH}$ to disable D_{out} .

- **AC Characteristics** ($T_A = 0$ to $+70^\circ\text{C}$, $V_{CC} = 5V \pm 10\%$, $V_{SS} = 0V$)^{17, 18}

Test Conditions

Input Rise and Fall Times: 5 ns
 Input timing reference levels: 0.8V, 2.4V
 Output load: 2 TTL Gate + C_L (100 pF)
 (Including scope and jig)

Read, Write, Read-Modify-Write and Refresh Cycles (Common Parameters)

Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Random Read or Write Cycle Time	t_{RC}	120	—	130	—	160	—	190	—	220	—	ns	
RAS Precharge Time	t_{RP}	50	—	50	—	70	—	80	—	90	—	ns	
RAS Pulse Width	t_{RAS}	60	10000	70	10000	80	10000	100	10000	120	10000	ns	
\overline{CS} Pulse Width	t_{SP}	20	10000	20	10000	25	10000	30	10000	30	10000	ns	
Row Address Setup Time	t_{ASR}	0	—	0	—	0	—	0	—	0	—	ns	
Row Address Hold Time	t_{RAH}	10	—	10	—	12	—	15	—	15	—	ns	
Column Address Setup Time	t_{ASW}	0	—	0	—	0	—	0	—	0	—	ns	
Column Address Hold Time	t_{AHW}	15	—	15	—	20	—	25	—	25	—	ns	
RAS to \overline{CS} Delay Time	t_{RCD}	20	40	20	50	22	55	25	70	25	90	ns	8
RAS Hold Time	t_{RSL}	20	—	20	—	25	—	30	—	30	—	ns	
\overline{CS} Hold Time	t_{CSH}	60	—	70	—	80	—	100	—	120	—	ns	
\overline{CS} to RAS Precharge Time	t_{SRS}	10	—	10	—	10	—	10	—	10	—	ns	
\overline{OE} to D_{in} Delay Time	t_{ODD}	20	—	20	—	20	—	25	—	30	—	ns	
\overline{OE} Delay Time from D_{in}	t_{DZO}	0	—	0	—	0	—	0	—	0	—	ns	
\overline{CS} Delay Time from D_{in}	t_{DZC}	0	—	0	—	0	—	0	—	0	—	ns	
Transition Time (Rise and Fall)	t_T	3	50	3	50	3	50	3	50	3	50	ns	1, 7
Refresh Period	t_{REF}	—	8	—	8	—	8	—	8	—	8	ms	

Read Cycle

Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Access Time from RAS	t_{RAC}	—	60	—	70	—	80	—	100	—	120	ns	2, 3
Access Time from \overline{CS}	t_{ACS}	—	20	—	20	—	25	—	30	—	30	ns	3, 4
Access Time from Address	t_{AA}	—	30	—	35	—	40	—	50	—	55	ns	3, 5, 14
Access Time from \overline{OE}	t_{OAC}	—	20	—	20	—	25	—	25	—	30	ns	
Read Command Setup Time	t_{RCS}	0	—	0	—	0	—	0	—	0	—	ns	
Read Command Hold Time to \overline{CS}	t_{RCH}	0	—	0	—	0	—	0	—	0	—	ns	
Read Command Hold Time to RAS	t_{RRH}	10	—	10	—	10	—	10	—	10	—	ns	



Read Cycle (continued)

Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
RAS to Column Address Hold Time	t _{AHR}	15	—	15	—	15	—	15	—	15	—	ns	16
RAS to Column Address Delay Time	t _{RAD}	15	30	15	35	17	40	20	50	20	65	ns	9
Column Address to RAS Lead Time	t _{RAL}	30	—	35	—	40	—	50	—	55	—	ns	
Column Address Hold Time from RAS	t _{AR}	60	—	70	—	80	—	100	—	120	—	ns	
Output Buffer Turn-off Time	t _{OFF}	—	20	—	20	—	20	—	25	—	30	ns	6
Output Buffer Turn-off to OE	t _{OFF2}	—	20	—	20	—	20	—	25	—	30	ns	6
Output Hold Time from Address	t _{AOH}	5	—	5	—	5	—	5	—	5	—	ns	
CS to D _{in} Delay Time	t _{CDD}	20	—	20	—	20	—	25	—	30	—	ns	
CS Hold Time from OE	t _{OCH}	20	—	20	—	25	—	25	—	30	—	ns	
OE Hold Time from RAS	t _{ROH}	60	—	70	—	80	—	100	—	120	—	ns	
OE Hold Time from CS	t _{COH}	20	—	20	—	25	—	25	—	30	—	ns	
OE Pulse Width	t _{OEP}	20	—	20	—	25	—	25	—	30	—	ns	

Write Cycle

Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Write Command Setup Time	t _{WCS}	0	—	0	—	0	—	0	—	0	—	ns	10
Write Command Hold Time	t _{WCH}	15	—	15	—	20	—	25	—	25	—	ns	
Write Command Hold Time to RAS	t _{WCR}	55	—	65	—	75	—	95	—	115	—	ns	
Write Command Pulse Width	t _{WP}	10	—	10	—	15	—	15	—	20	—	ns	
Write Command to RAS Lead Time	t _{RWL}	20	—	20	—	25	—	25	—	30	—	ns	
Write Command to CS Lead Time	t _{CWL}	20	—	20	—	25	—	25	—	30	—	ns	
D _{in} Setup Time	t _{DS}	0	—	0	—	0	—	0	—	0	—	ns	11
D _{in} Hold Time	t _{DH}	15	—	15	—	20	—	25	—	25	—	ns	11
D _{in} Hold Time to RAS	t _{DHR}	55	—	65	—	75	—	95	—	115	—	ns	
Column Address Hold Time from RAS	t _{AWR}	55	—	65	—	75	—	95	—	115	—	ns	

Read-Modify-Write Cycle

Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Read-Modify-Write Cycle Time	t _{RWC}	170	—	180	—	220	—	255	—	295	—	ns	
RAS to WE Delay Time	t _{RWD}	85	—	93	—	110	—	135	—	160	—	ns	10
CS to WE Delay Time	t _{CWD}	45	—	45	—	55	—	65	—	70	—	ns	10
Column Address to WE Delay Time	t _{AWD}	55	—	60	—	70	—	85	—	95	—	ns	10

Refresh Cycle

Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
CS Setup Time (CS Before RAS Refresh Cycle)	t _{CSR}	10	—	10	—	10	—	10	—	10	—	ns	
CS Hold Time (CS Before RAS Refresh Cycle)	t _{CHR}	15	—	15	—	20	—	20	—	25	—	ns	
RAS Precharge to CS Hold Time	t _{ZRH}	10	—	10	—	10	—	10	—	10	—	ns	



Static Column Mode Cycle

Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Static Column Mode Cycle Time	t_{SC}	35	—	40	—	45	—	55	—	60	—	ns	
Static Column Mode RAS Pulse Width	t_{RASC}	—	100000	—	100000	—	100000	—	100000	—	100000	ns	
RAS to Second \overline{WE} Delay Time	t_{RSWD}	70	—	80	—	90	—	110	—	135	—	ns	
Static Column Mode \overline{CS} Precharge Time	t_{SI}	10	—	10	—	10	—	10	—	15	—	ns	
Static Column Mode \overline{WE} Precharge Time	t_{WI}	10	—	10	—	10	—	10	—	15	—	ns	

Static Column Mode Read-Modify-Write Cycle and Mixed Cycle

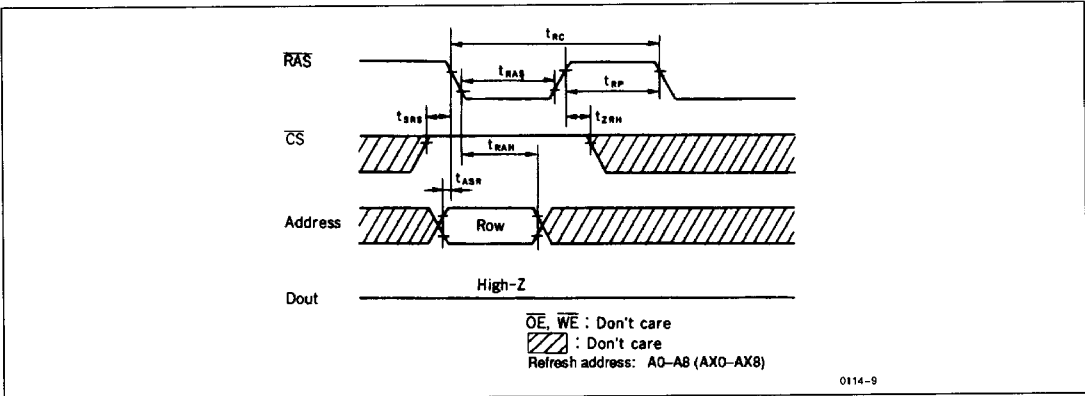
Parameter	Symbol	HM514258A -6		HM514258A -7		HM514258A -8		HM514258A -10		HM514258A -12		Unit	Note
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Static Column Mode Cycle Time on Read-Modify-Write	t_{SRW}	90	—	100	—	120	—	140	—	160	—	ns	12
Access Time from First \overline{WE}	t_{ALW}	—	65	—	75	—	85	—	100	—	115	ns	3, 13
Last \overline{WE} to Column Address Delay Time	t_{LWAD}	20	35	20	40	25	45	25	50	30	60	ns	15
Last \overline{WE} to Column Address Hold Time	t_{AHLW}	65	—	75	—	85	—	100	—	115	—	ns	

Notes: 1. AC measurements assume $t_T = 5$ ns.

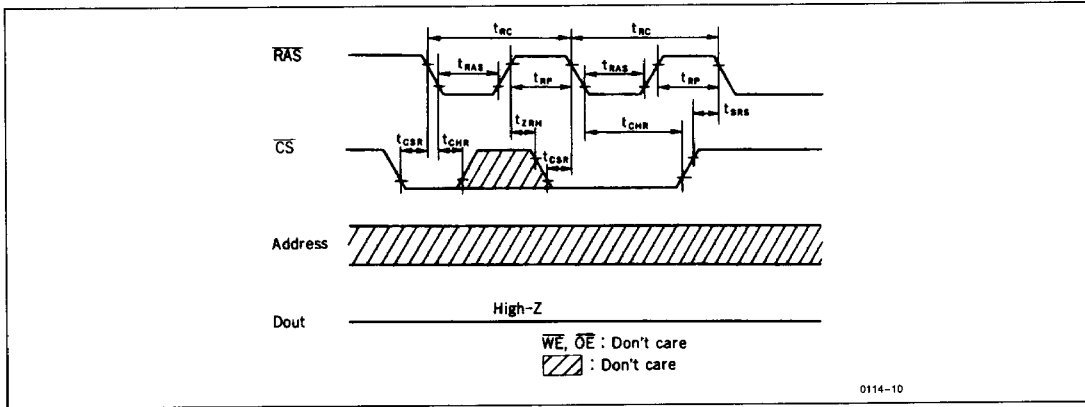
- Assumes that $t_{RCD} \leq t_{RCD}(\max)$ and $t_{RAD} \leq t_{RAD}(\max)$. If t_{RCD} or t_{RAD} is greater than the maximum recommended value shown in this table, t_{RAC} exceeds the value shown.
- Measured with a load circuit equivalent to 2 TTL load and 100 pF.
- Assumes that $t_{RCD} \geq t_{RCD}(\max)$ and $t_{RAD} \leq t_{RAD}(\max)$.
- Assumes that $t_{RCD} \leq t_{RCD}(\max)$ and $t_{RAD} \geq t_{RAD}(\max)$.
- $t_{OFF}(\max)$ is defined as the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
- Transition times are measured between V_{IH} and V_{IL} .
- Operation with the $t_{RCD}(\max)$ limit insures that $t_{RAC}(\max)$ can be met, $t_{RCD}(\max)$ is specified as a reference point only, if t_{RCD} is greater than the specified $t_{RCD}(\max)$ limit, then access time is controlled exclusively by t_{ACS} .
- Operation with the $t_{RAD}(\max)$ limit insures that $t_{RAC}(\max)$ can be met, $t_{RAD}(\max)$ is specified as a reference point only, if t_{RAD} is greater than the specified $t_{RAD}(\max)$ limit, then access time is controlled exclusively by t_{AA} .
- t_{WCS} , t_{RWD} , t_{CWD} and t_{AWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only: if $t_{WCS} \geq t_{WCS}(\min)$, the cycle is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle; if $t_{RWD} \geq t_{RWD}(\min)$, $t_{CWD} \geq t_{CWD}(\min)$ and $t_{AWD} \geq t_{AWD}(\min)$ the cycle is a read-modify-write and the data output will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indeterminate.
- These parameters are referenced to \overline{CS} leading edge in early write cycles and to \overline{WE} leading edge in delayed write or read-modify-write cycles.
- $t_{SRW}(\min) = t_{AWD}(\min) + t_{LWAD}(\max) + t_T$
- Assumes that $t_{LWAD} \leq t_{LWAD}(\max)$. If t_{LWAD} is greater than the maximum recommended value shown in this table, t_{ALW} exceeds the value shown.
- Assumes that $t_{LWAD} \geq t_{LWAD}(\max)$.
- Operation with the $t_{LWAD}(\max)$ limit insures that $t_{ALW}(\max)$ can be met, $t_{LWAD}(\max)$ is specified as a reference point only, if t_{LWAD} is greater than the specified $t_{LWAD}(\max)$ limit, then access time is controlled exclusively by t_{AA} .
- t_{AHR} is defined as the time at which the column address hold is set.
- An initial pause of 100 μ s is required after power-up followed by eight or more initialization cycles (any combination of cycles containing \overline{RAS} clock such as \overline{RAS} only refresh). If internal refresh counter is used, eight or more \overline{CS} before \overline{RAS} refresh cycles are required.
- In delayed write or read-modify-write cycles, \overline{OE} must disable output buffers prior to applying data to the device.



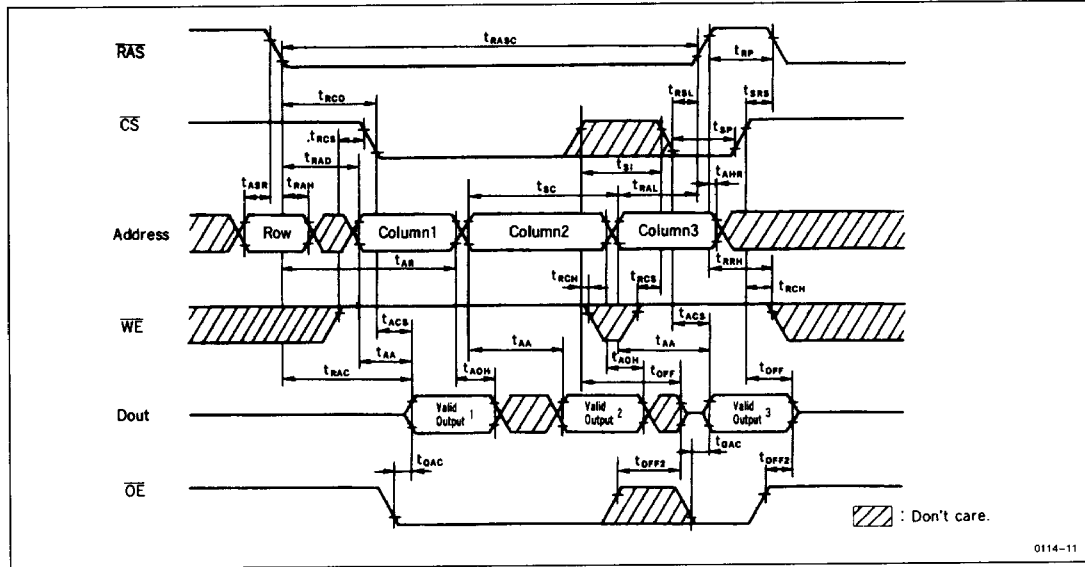
• RAS Only Refresh Cycle



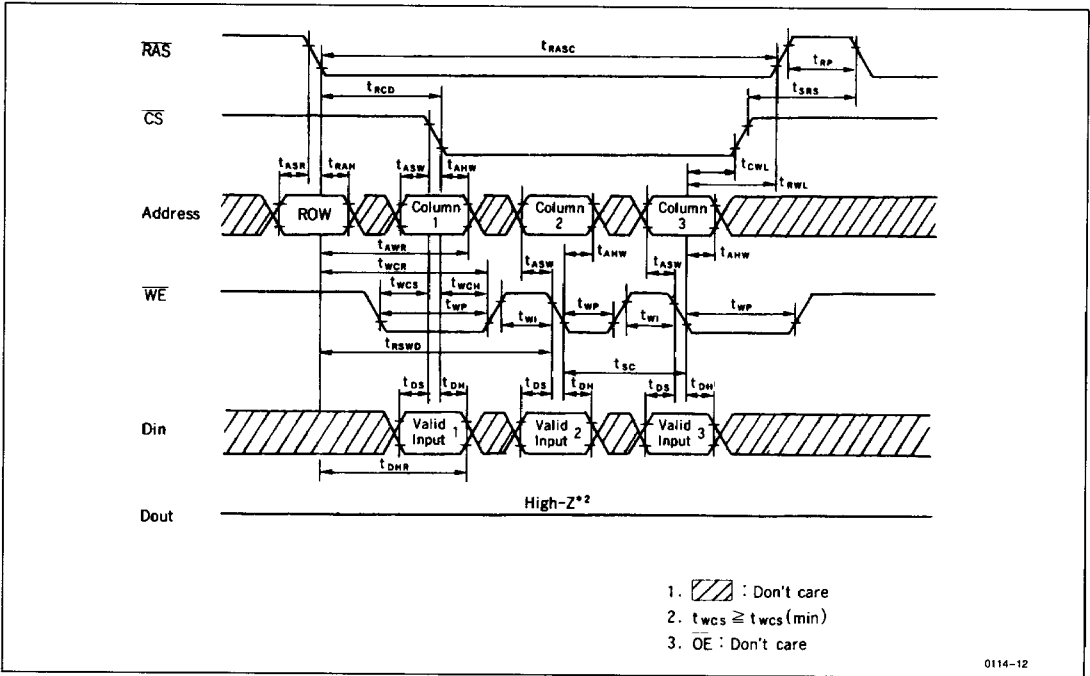
• CS Before RAS Refresh Cycle



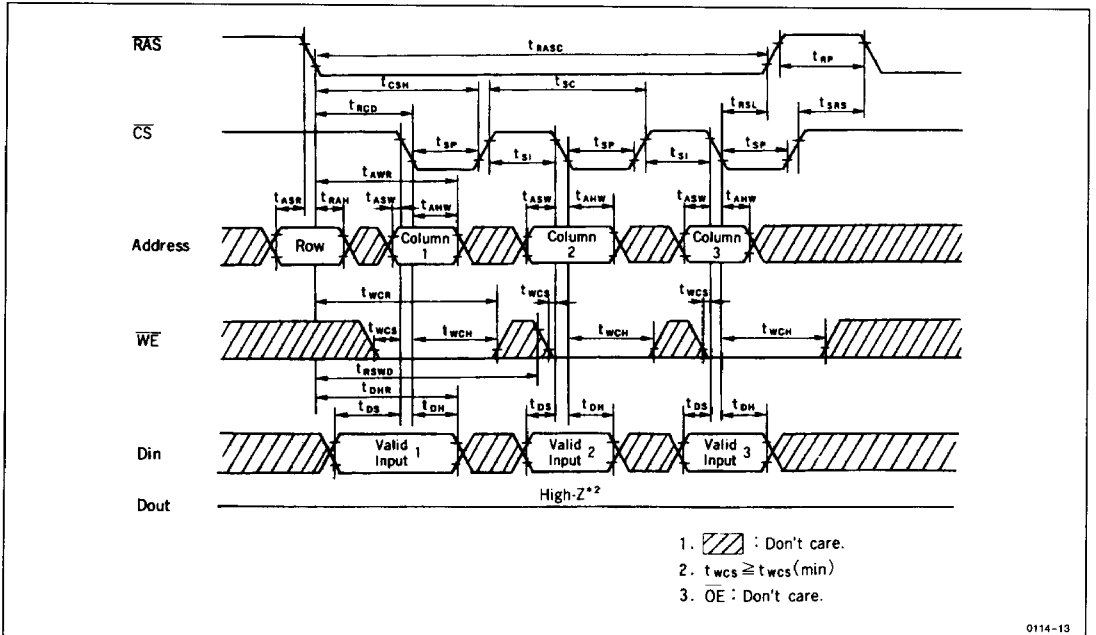
• Static Column Mode Read Cycle



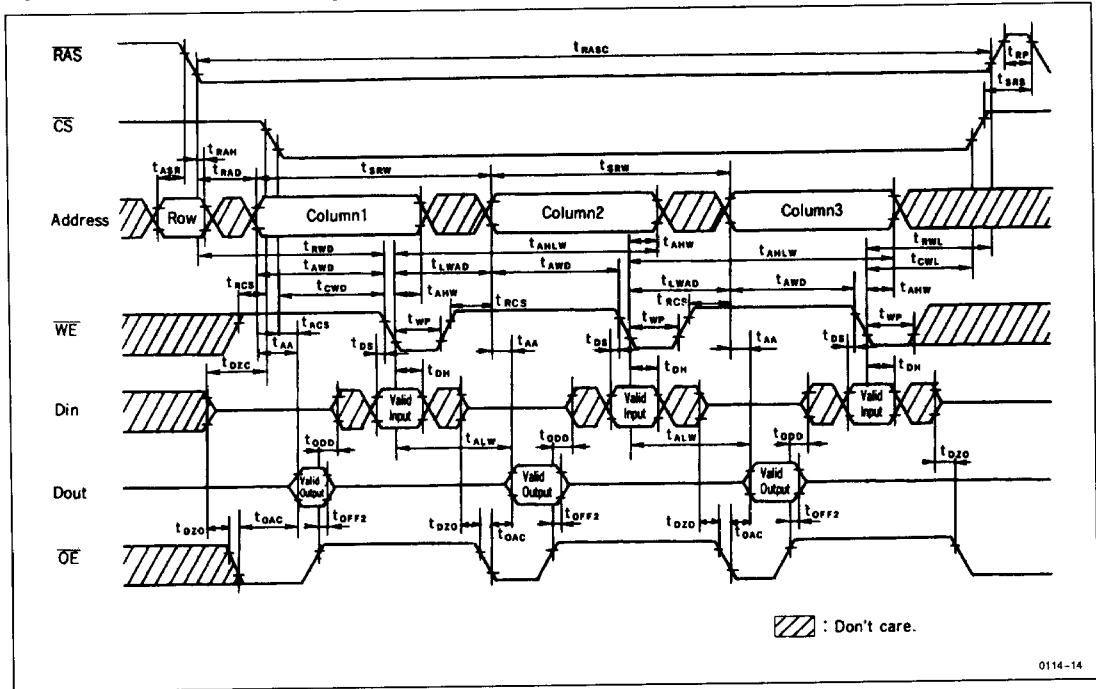
• Static Column Mode Write Cycle (1)



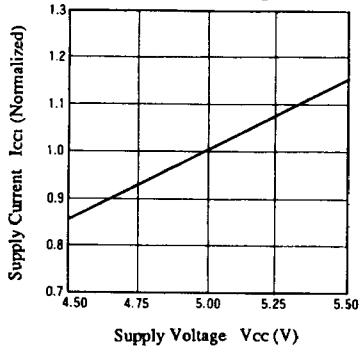
• Static Column Mode Write Cycle (2)



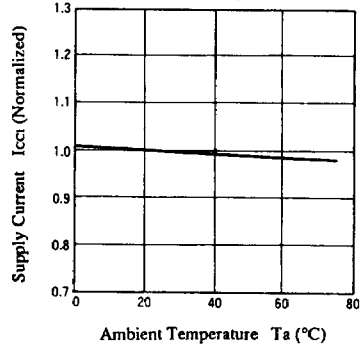
• Static Column Mode Read-Modify-Write Cycle



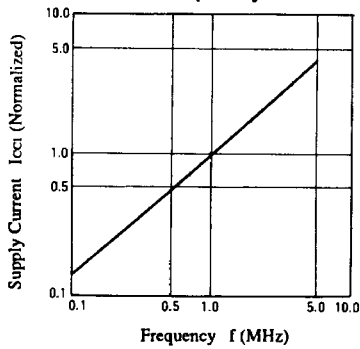
Supply Current (Active) vs Supply Voltage



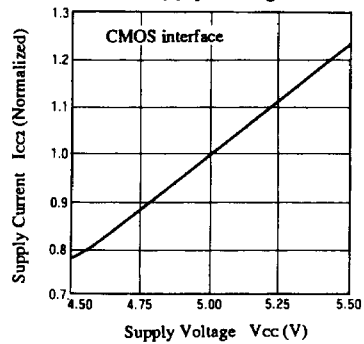
Supply Current (Active) vs Ambient Temperature



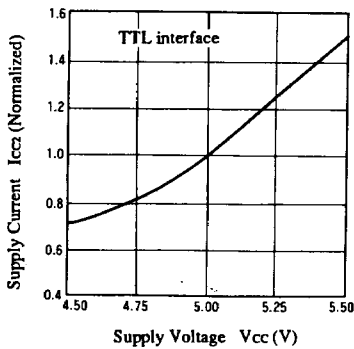
Supply Current (Active) vs Frequency



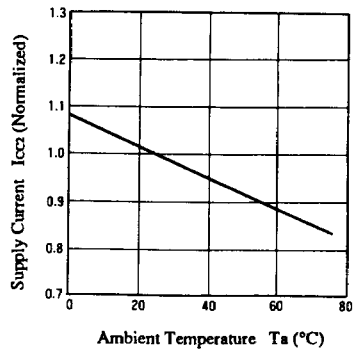
Supply Current (Standby) vs Supply Voltage



Supply Current (Standby) vs Supply Voltage



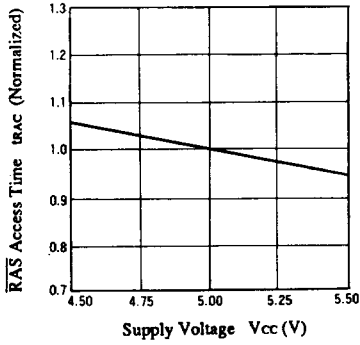
Supply Current (Standby) vs Ambient Temperature



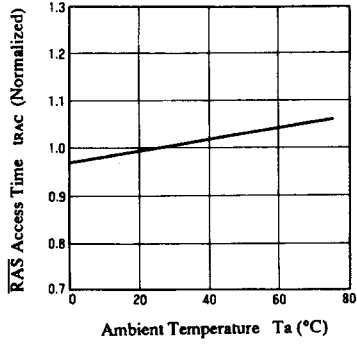
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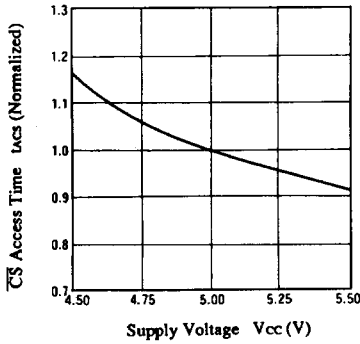
RAS Access Time vs Supply Voltage



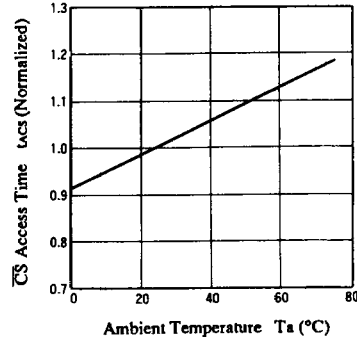
RAS Access Time vs Ambient Temperature



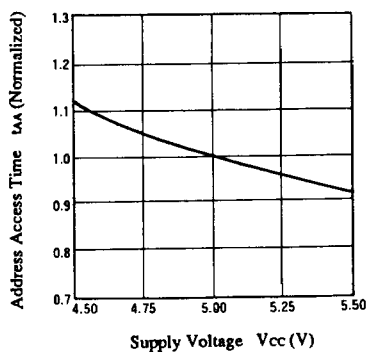
CS Access Time vs Supply Voltage



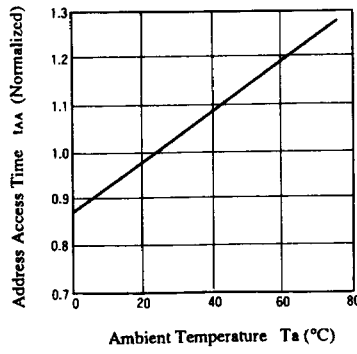
CS Access Time vs Ambient Temperature



Address Access Time vs Supply Voltage



Address Access Time vs Ambient Temperature



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