NN518125 series EDO (Hyper Page) Mode CMOS 128K × 8bit Dynamic RAM

NPNX

DESCRIPTION

The NN518125 series is a high performance CMOS Dynamic Random Access Memory organized as 131,072 words by 8-bits. The NN518125 series is fabricated with advanced CMOS technology and designed with innovative design techniques resulting in high speed, extremely low power and wide operating margins at both component and system levels.

The NN518125 series features an EDO (Hyper page) mode operation in which a high speed read, write or read-write is performed on any column address along a row address.

An extremely short row address capture time and an asynchronous column address decoder relax the timing constraints associated with address multiplexing.

Refresh is accomplished by performing $\overline{RAS}$ only refresh cycles, hidden refresh cycles, $\overline{CAS}$ before $\overline{RAS}$ refresh cycles, or normal read or write cycles on the 512 address combinations of A0 to A8 during a 8 ms period.

Multiplexed address inputs permit the NN518125 series to be packaged in a standard 26-pin plastic SOJ. The package sizes provide high system bit densities and are compatible with widely available automated testing and insertion equipment. System level features include single power supply of 5V ±10% tolerance and direct interface with high performance TTL logic families.

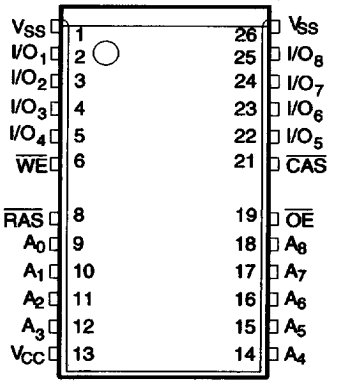
FEATURES

- 131,072 × 8 bit Organization
- Single 5V ±10% Power Supply
- Performance Ranges

Parameter		-45	-50	-60	-70
Max. $\overline{RAS}$ Access Time	(t_{RAC})	45ns	50ns	60ns	70ns
Max. $\overline{CAS}$ Access Time	(t_{CAC})	15ns	15ns	15ns	20ns
Max. Column Address Access Time	(t_{AA})	23ns	25ns	30ns	35ns
Min. Read/Write Cycle Time	(t_{RC})	90ns	90ns	110ns	130ns

- EDO (Hyper Page) Mode Operation
- Low Power Operation
  Low Standby Current (CMOS level inputs)
  – Standard 1mA
  – L version 50µA
- 512 Refresh Cycles
  – Standard distributed across 8ms
  – L version distributed across 32ms
- Self Refresh Mode
  (L version)
- All inputs/Outputs and Clocks
  fully TTL and CMOS compatible
- Refresh Modes
  $\overline{RAS}$ only
  $\overline{CAS}$ before $\overline{RAS}$
  Hidden Refresh
- High Reliability Packages
  Plastic 26pin SOJ (P26/24SJ-2A)

PIN CONFIGURATION (TOP VIEW)

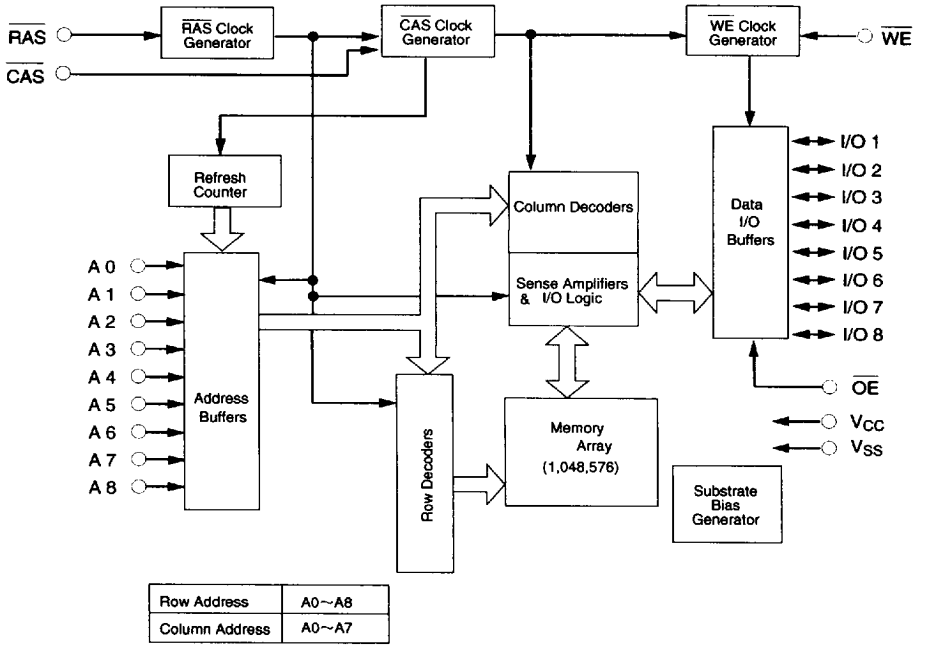


26/24-pin SOJ (300 mil)
P26/24SJ-2A

PIN NAMES

A0~A8	Address Inputs
$\overline{RAS}$	Row Address Strobe
$\overline{CAS}$	Column Address Strobe
$\overline{OE}$	Output Enable
I/O1~I/O8	Data-in / Data-out
$\overline{WE}$	Write Enable
V_{CC}	+5V Supply
V_{SS}	Ground
NC	No Connection

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

RATING	SYMBOL	VALUE	UNIT
Voltage on Any Pin Relative to V_{SS}	Vin,Vout	−1 to 7	V
Voltage on Vcc Relative to V_{SS}	V_{CC}	−1 to 7	V
Storage Temperature (Plastic)	Tstg	−55 to +125	°C
Power Dissipation	Pd	1.0	W
Ambient Operating Temperature	Ta	0 to + 70	°C
Short Circuit Output Current	Iout	50	mA

Permanent device damage can occur if absolute maximum ratings are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods can affect device reliability.

DC OPERATING CONDITIONS

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{CC}	Supply Voltage	4.5	5.0	5.5	V
V_{SS}	Supply Voltage	0	0	0	V
V_{IH}	Input High Voltage, All Inputs	2.4	—	6.5	V
V_{IL}	Input Low Voltage, All Inputs	−1.0	—	0.8	V

Note: All voltage values in this data sheet are with respect to V_{SS} unless otherwise specified.

DC ELECTRICAL CHARACTERISTICS (0°C ≤ Ta ≤ 70°C, V_{CC} = 5.0V ±10%)

SYMBOL	PARAMETER	SPEED	MIN.	MAX.	UNIT	TEST CONDITIONS	NOTES
I_{CC1}	Operating Current	-45		100	mA	t_{RC} = t_{RC} (min.)	1, 2
		-50		100	mA	$\overline{RAS}$, $\overline{CAS}$, Address cycling	
		-60		90	mA		
		-70		80	mA		
I_{CC2}	Standby Current			1.0	mA	$\overline{RAS}$ = $\overline{CAS}$ ≥ (V_{CC} - 0.2V)	
				2.0	mA	$\overline{RAS}$ = $\overline{CAS}$ ≥ V_{IH}	
	Standby Current (L version)			50	µA	$\overline{RAS}$ = $\overline{CAS}$ ≥ (V_{CC} - 0.2V) All other inputs are stable at (V_{CC} - 0.2V) or (V_{SS} + 0.2V)	
I_{CC3}	Refresh Current ($\overline{RAS}$ only refresh)	-45		100	mA	t_{RC} = t_{RC} (min.)	1
		-50		100	mA	$\overline{RAS}$ cycling, $\overline{CAS}$ = V_{IH}	
		-60		90	mA		
		-70		80	mA		
I_{CC4}	EDO (Hyper) Page Mode Current	-45		100	mA	t_{HPC} = t_{HPC} (min.)	1,2
		-50		100	mA	$\overline{RAS}$ = V_{IL}	
		-60		90	mA	$\overline{CAS}$, Address cycling	
		-70		80	mA		
I_{CC5}	Refresh Current ($\overline{CAS}$ before $\overline{RAS}$ refresh)	-45		100	mA	t_{RC} = t_{RC} (min.)	1
		-50		100	mA	$\overline{RAS}$, $\overline{CAS}$ cycling	
		-60		90	mA		
		-70		80	mA		
I_{CC6}	Refresh Current (L version:$\overline{CAS}$ before $\overline{RAS}$ refresh)			150	µA	512 cycles / 32ms t_{RAS} ≤ 200ns, $\overline{WE}$ ≥ (V_{CC} - 0.2V) All other inputs are stable at (V_{CC} - 0.2V) or (V_{SS} + 0.2V)	
I_{CC7}	Self Refresh Mode Current (L version)			100	µA	$\overline{RAS}$ =$\overline{CAS}$ ≤ (V_{SS} + 0.2V) All other input high levels are (V_{CC} - 0.2V) or input low levels are (V_{SS} + 0.2V)	
$\|I_{LI}\|$	Input Leakage Current (Any input pin)		-10	10	µA	0V ≤ V_{IH} ≤ 5.5V, Others = 0V	
$\|I_{LO}\|$	Output Leakage Current (For high impedance state)		-10	10	µA	$\overline{RAS}$ ≥ V_{IH}(min), $\overline{CAS}$ ≥ V_{IH}(min) 0V ≤ V_{OUT} ≤ 5.5V	
V_{OH}	Output High Voltage		2.4		V	I_{OH} = –5.0 mA	
V_{OL}	Output Low Voltage			0.4	V	I_{OL} = 4.2 mA	

Notes: 1. I_{CC1} , I_{CC3} , I_{CC4} and I_{CC5} depend on cycle rate.
2. I_{CC1} and I_{CC4} depend on output loading. Specified values are obtained with the outputs open.

CAPACITANCE (0°C ≤ Ta ≤ 70°C, V_{CC} = 5.0V ±10%, f = 1MHz)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
C_{IN1}	Address(A0 ~ A8)	—	5	pF
C_{IN2}	$\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$,$\overline{OE}$	—	5	pF
C_{OUT}	(I/O1 ~ I/O8)	—	7	pF

AC ELECTRICAL CHARACTERISTICS

(NN518125 -50 / -60 / -70)

Test conditions : V_{IH} / V_{IL} = 2.4V / 0.8V V_{OH} / V_{OL} = 2.4V / 0.4V output loading C_L = 50pF + 2TTL

Operating conditions : (0 °C≤Ta≤70°C, V_{CC} = 5 V ± 10%, V_{SS} = 0 V) (NOTES 3, 4, 5)

(NN518125 -45)

Test conditions : V_{IH} / V_{IL} = 2.4V / 0.8V V_{OH} / V_{OL} = 2.0V / 0.8V output loading C_L = 50pF + 1TTL

Operating conditions : (0 °C≤Ta≤70°C, V_{CC} = 5 V ± 5%, V_{SS} = 0 V) (NOTES 3, 4, 5)

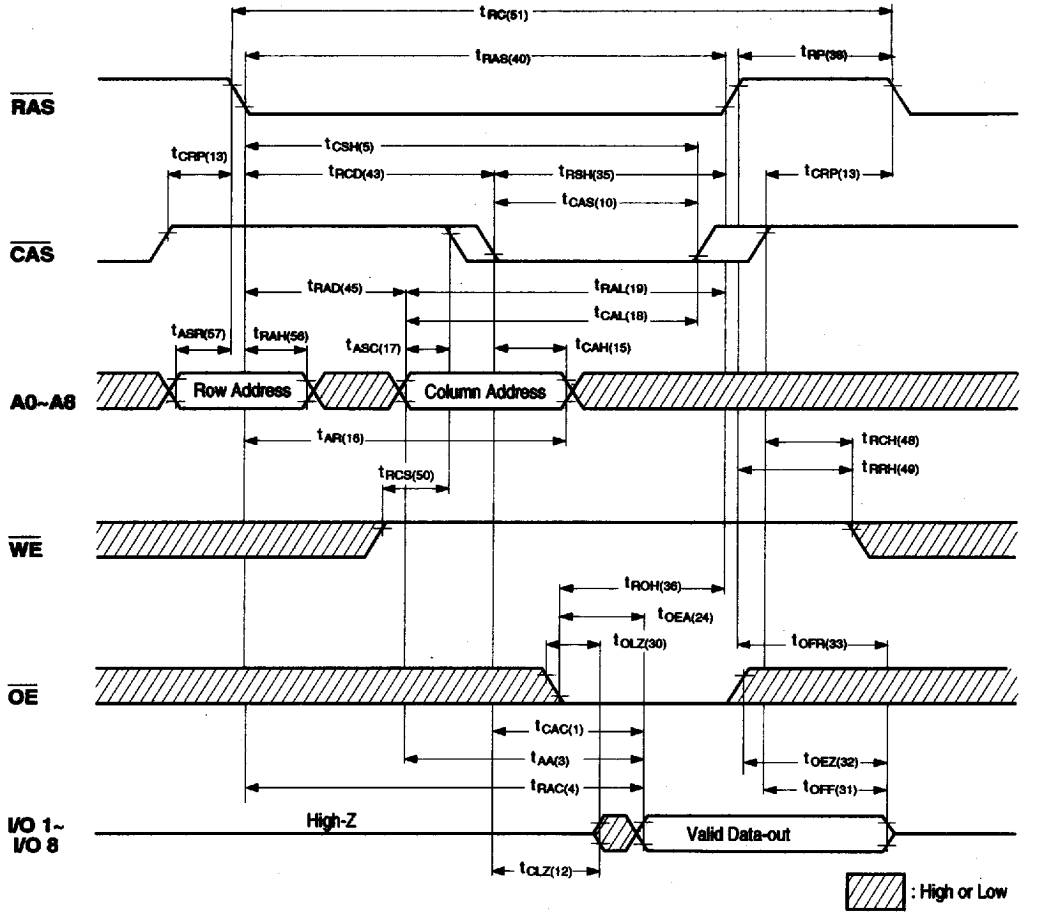
NO.	NOTES		PARAMETER	-45		-50		-60		-70		UNIT	NOTE
	JEDEC	STD.		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
1	t_{CL1QV}	t_{CAC}	Access Time from $\overline{CAS}$	—	15	—	15	—	15	—	20	ns	6,13
2	t_{CH2QV}	t_{CPA}	Access Time from $\overline{CAS}$ Precharge	—	30	—	30	—	35	—	40	ns	13,14
3	t_{AVQV}	t_{AA}	Access Time from Column Address	—	23	—	25	—	30	—	35	ns	7,13
4	t_{RL1QV}	t_{RAC}	Access Time from $\overline{RAS}$	—	45	—	50	—	60	—	70	ns	6,7
5	t_{RL1CH1}	t_{CSH}	$\overline{CAS}$ Hold Time	30	—	35	—	45	—	55	—	ns	
6	t_{RL1CX}	t_{CHS}	$\overline{CAS}$ Hold Time (Self Refresh Mode)	-50	—	-50	—	-50	—	-50	—	ns	
7	t_{RL1CH1}	t_{CHR}	$\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	10	—	10	—	10	—	10	—	ns	
8	t_{CH2CL2}	t_{CPN}	$\overline{CAS}$ Precharge Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	10	—	10	—	10	—	10	—	ns	
9	t_{CH2CL2}	t_{CP}	$\overline{CAS}$ Precharge Time (EDO (Hyper Page) Mode)	5	—	5	—	5	—	5	—	ns	14
10	t_{CL1CH1}	t_{CAS}	$\overline{CAS}$ Pulse Width	8	100K	8	100K	10	100K	15	100K	ns	
11	t_{CL1RL2}	t_{CSR}	$\overline{CAS}$ Setup Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	5	—	5	—	5	—	5	—	ns	
12	t_{CL1QX}	t_{CLZ}	$\overline{CAS}$ to Output in Low-Z	0	—	0	—	0	—	0	—	ns	8
13	t_{CH2RL2}	t_{CRP}	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5	—	5	—	5	—	5	—	ns	
14	t_{CL1WL2}	t_{CWD}	$\overline{CAS}$ to $\overline{WE}$ Delay Time	45	—	45	—	45	—	50	—	ns	11
15	t_{CL1AX}	t_{CAH}	Column Address Hold Time	10	—	10	—	15	—	15	—	ns	
16	t_{RL1AX}	t_{AR}	Column Address Hold Time Referenced to $\overline{RAS}$	35	—	35	—	40	—	40	—	ns	
17	t_{AVCL2}	t_{ASC}	Column Address Setup Time	0	—	0	—	0	—	0	—	ns	14
18	t_{AVCH1}	t_{CAL}	Column Address to $\overline{CAS}$ Lead Time	13	—	13	—	18	—	23	—	ns	
19	t_{AVRH1}	t_{RAL}	Column Address to $\overline{RAS}$ Lead Time	27	—	27	—	30	—	35	—	ns	
20	t_{AVWL2}	t_{AWD}	Column Address to $\overline{WE}$ Delay Time	57	—	57	—	60	—	65	—	ns	11
21	t_{CL1DX} t_{WL1DX}	t_{DH}	Data Hold Time	10	—	10	—	10	—	10	—	ns	12
22	t_{CL2QX}	t_{DHC}	Data Output Hold Time (EDO (Hyper Page) Mode)	0	—	0	—	0	—	0	—	ns	
23	t_{DVCL2} t_{DVWL2}	t_{DS}	Data Setup Time	0	—	0	—	0	—	0	—	ns	12
24	t_{OL1QV}	t_{OEA}	$\overline{OE}$ Access Time	—	15	—	15	—	15	—	20	ns	
25	t_{WL1OL2}	t_{OEH}	$\overline{OE}$ Command Hold Time	15	—	15	—	15	—	20	—	ns	
26	t_{GH2GL2}	t_{OPZ}	$\overline{OE}$ Pulse Width for Output Disable When $\overline{CAS}$ High	7	—	7	—	7	—	7	—	ns	
27	t_{GL1CH1}	t_{OCS}	$\overline{OE}$ Setup Time to $\overline{CAS}$ High	7	—	7	—	7	—	7	—	ns	
28	t_{GL1RH1}	t_{ORS}	$\overline{OE}$ Setup Time to $\overline{RAS}$ High	7	—	7	—	7	—	7	—	ns	
29	t_{CH2QV}	t_{OED}	$\overline{OE}$ to Data Delay Time	10	—	10	—	10	—	10	—	ns	
30	t_{GL2QX}	t_{OLZ}	$\overline{OE}$ to Output in low-Z	0	—	0	—	0	—	0	—	ns	
31	t_{CH2QZ}	t_{OFF}	Output Buffer Turn-off Delay Time	0	13	0	13	0	15	0	15	ns	10
32	t_{OH2QX}	t_{OEZ}	Output Buffer Turn-off Delay Time Referenced to $\overline{OE}$	0	10	0	10	0	15	0	15	ns	

NO.	SYMBOL		PARAMETER	-45		-50		-60		-70		UNIT	NOTE
	JEDEC	STD.		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
33	t_{RHQZ}	t_{OFR}	Output Buffer Turn-off Delay Time Referenced to $\overline{RAS}$	0	20	0	20	0	20	0	20	ns	16
34	t_{WL2QZ}	t_{WEZ}	Output Buffer Turn-off Delay Time Referenced to $\overline{WE}$	0	13	0	13	0	15	0	15	ns	
35	t_{CL1RH1}	t_{RSH}	$\overline{RAS}$ Hold Time	15	—	15	—	15	—	20	—	ns	
36	t_{OL1RH1}	t_{ROH}	$\overline{RAS}$ Hold Time Referenced to $\overline{OE}$	10	—	10	—	10	—	10	—	ns	
37	t_{CH2RH1}	t_{RHCP}	$\overline{RAS}$ Hold Time Referenced $\overline{CAS}$ Precharge	30	—	30	—	35	—	40	—	ns	
38	t_{RH2RL2}	t_{RP}	$\overline{RAS}$ Precharge Time	25	—	25	—	30	—	40	—	ns	
39	t_{RH2RL2}	t_{RPS}	$\overline{RAS}$ Precharge Time (Self Refresh Mode)	90	—	90	—	110	—	130	—		
40	t_{RL1RH1}	t_{RAS}	$\overline{RAS}$ Pulse Width	45	100K	50	100K	60	100K	70	100K	ns	
41	t_{RL1RH1}	t_{RASS}	$\overline{RAS}$ Pulse Width (Self Refresh Mode)	300	—	300	—	300	—	300	—	µs	
42	t_{RL1RH1}	t_{RASP}	$\overline{RAS}$ Pulse Width (EDO (Hyper Page) Mode)	45	100K	50	100K	60	100K	70	100K	ns	
43	t_{RL1CL1}	t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	13	30	13	35	13	45	13	50	ns	6
44	t_{RH2CL2}	t_{RPC}	$\overline{RAS}$ to $\overline{CAS}$ Precharge Time	10	—	10	—	10	—	10	—	ns	
45	t_{RL1AV}	t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	11	23	11	23	11	30	11	35	ns	7
46	t_{RL2QX}	t_{RLZ}	$\overline{RAS}$ To Output in Low-Z	0	—	0	—	0	—	0	—	ns	
47	t_{RL1WL2}	t_{RWD}	$\overline{RAS}$ to $\overline{WE}$ Delay Time	80	—	80	—	90	—	100	—	ns	11
48	t_{CH2WL2}	t_{RCH}	Read Command Hold Time	0	—	0	—	0	—	0	—	ns	9
49	t_{RH2WL2}	t_{RRH}	Read Command Hold Time Referenced to $\overline{RAS}$	10	—	10	—	10	—	10	—	ns	9
50	t_{WH2CL2}	t_{RCS}	Read Command Setup Time	0	—	0	—	0	—	0	—	ns	
51	t_{RL2RL2}	t_{RC}	Random Read or Write Cycle Time	90	—	90	—	110	—	130	—	ns	
52	t_{CL2CL2}	t_{HPC}	Read or Write Cycle Time (EDO (Hyper Page) Mode)	20	—	20	—	25	—	30	—	ns	13,14
53	t_{RL2RL2}	t_{RMW}	Read-Modify-Write Cycle Time	145	—	145	—	165	—	185	—	ns	
54	t_{CL2CL2}	t_{PRMW}	Read-Modify-Write Cycle Time (EDO (Hyper Page) Mode)	82	—	82	—	85	—	95	—	ns	13,14
55	t_{REF}	t_{REF}	Refresh Period	—	8	—	8	—	8	—	8	ms	15
56	t_{RL1AX}	t_{RAH}	Row Address Hold Time	8	—	8	—	8	—	8	—	ns	
57	t_{AVRL2}	t_{ASR}	Row Address Setup Time	0	—	0	—	0	—	0	—	ns	
58	t_T	t_T	Transition Time (Rise and Fall)	2	50	2	50	2	50	2	50	ns	4,5
59	t_{WL1WH1}	t_{WPZ}	$\overline{WE}$ Pulse Width for Disable When $\overline{CAS}$ High	7	—	7	—	7	—	7	—	ns	
60	t_{CL1WH1}	t_{WCH}	Write Command Hold Time	10	—	10	—	10	—	15	—	ns	
61	t_{WL1WH1}	t_{WP}	Write Command Pulse Width	10	—	10	—	10	—	15	—	ns	
62	t_{WL1CL2}	t_{WCS}	Write Command Setup Time	0	—	0	—	0	—	0	—	ns	11
63	t_{WL1CH1}	t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	15	—	15	—	15	—	20	—	ns	
64	t_{WL1RH1}	t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	15	—	15	—	15	—	20	—	ns	

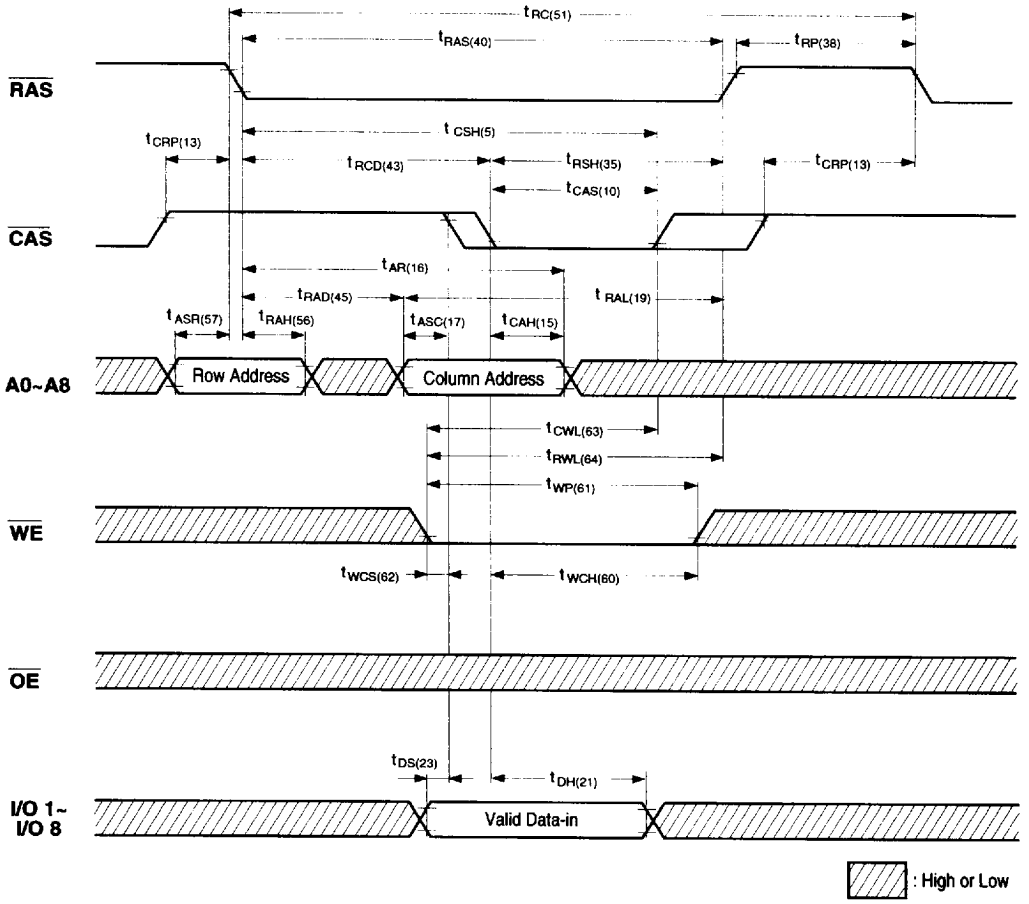
Notes:

3. Eight Initialization Cycles are required following a 200μs pause after Power Up. These Initialization Cycles may consist of any combination of the following : $\overline{RAS}$ only refresh Cycles, Read Cycles, Write Cycles. $\overline{CAS}$ before $\overline{RAS}$ refresh Cycles.
4. AC measurements assume t_T=3ns. All AC parameters are measured with V_{IL}(min.)≥V_{SS} and V_{IH}(max.)≤V_{CC} and with a load equivalent to two TTL loads and 50pF.(-50/-60/-70) / one TTL loads and 50pF.(-45)
5. V_{IH}(min.) and V_{IL}(max.) are reference levels for measuring timing of input signals. Also, transition times are measured between V_{IH} and V_{IL}.
6. Operation within the t_{RCD}(max.) limit ensures 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 by t_{CAC}.
7. Operation within the t_{RAD}(max.) limit ensures 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 by t_{AA}.
8. Assumes three state test load (5pF and a 220 ohm to 1.3V Thevenin equivalent).
9. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
10. t_{OFF}(max.) defines the time at which the output achieves an open circuit condition and is not referenced to output voltage levels. t_{OFF} only applies when $\overline{RAS}$ is high.
11. 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}≥t_{WCS}(min.) , the cycle is an early write cycle and data-out pins will remain open circuit (high impedance) throughout the entire cycle. If t_{RWD}≥t_{RWD}(min.), t_{CWD}≥t_{CWD}(min.) and t_{AWD}≥t_{AWD}(min.), the cycle is a read-modify-write cycle and the data-out will contain data read from the selected cell. If neither of the above conditions is satisfied, the condition of the data-out (at access time) is indeterminate.
12. These parameters are referenced to $\overline{CAS}$ leading edge in early write cycles and to $\overline{WE}$ leading edge in read-modify-write cycles.
13. Access time is determined by the longer of t_{AA}, t_{CAC}, or t_{CPA}.
14. t_{ASC}≥t_{CP} to achieve t_{PC}(min.) and t_{CPA}(max.) values.
15. t_{REF}=32msec for Long Refresh version (L version).
16. t_{OFR} applies only when $\overline{CAS}$ is high.

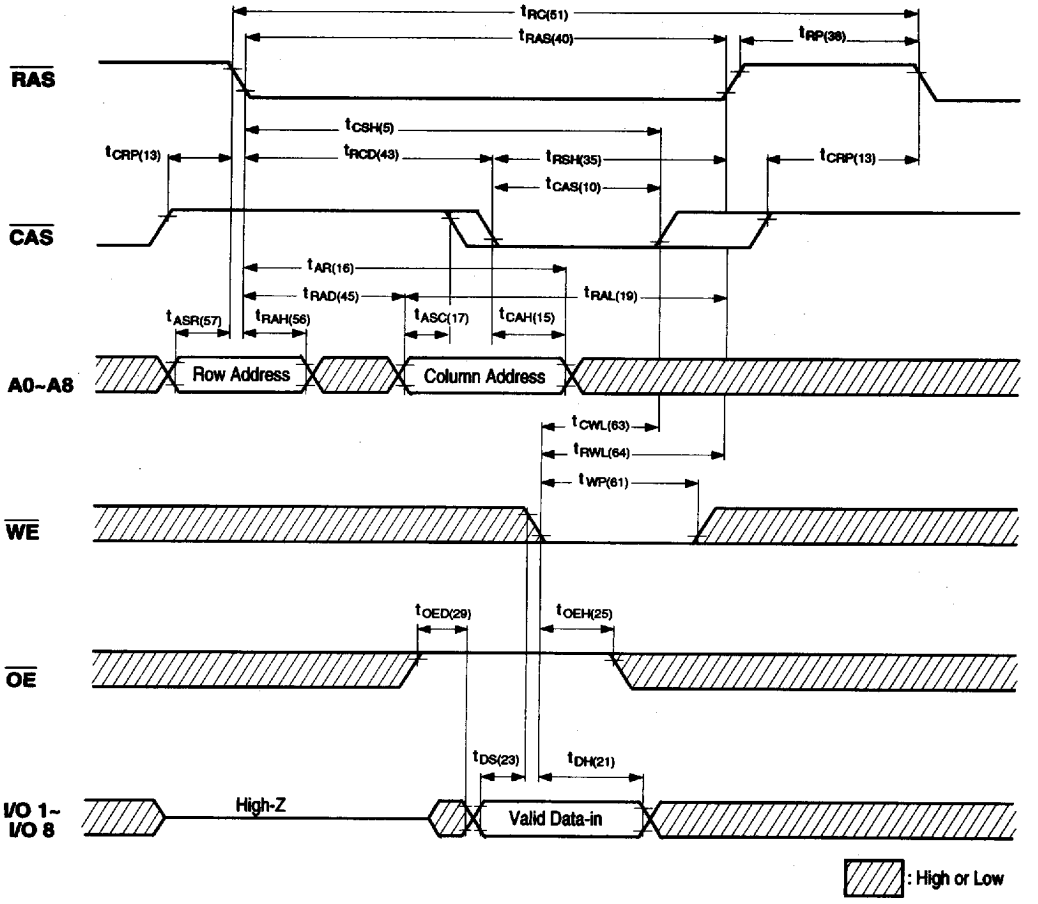
READ CYCLE



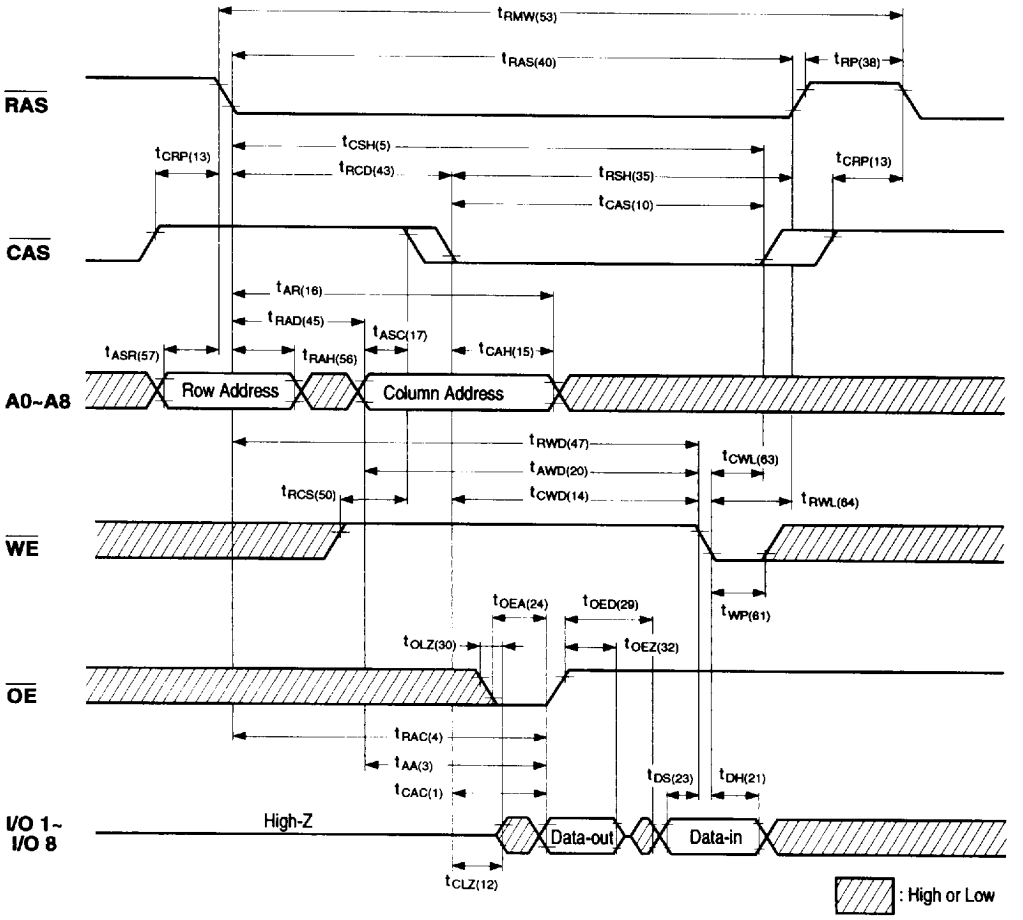
WRITE CYCLE (EARLY WRITE)



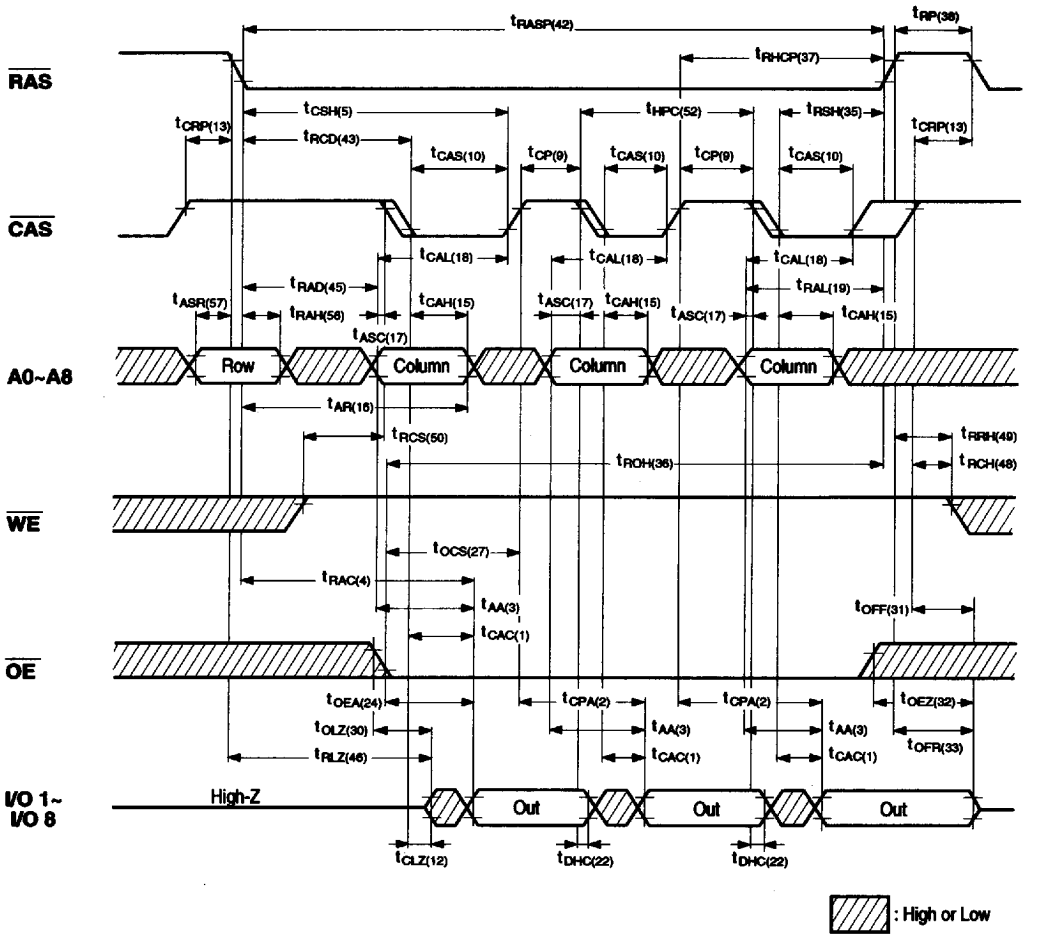
WRITE CYCLE ($\overline{OE}$-CONTROLLED WRITE)



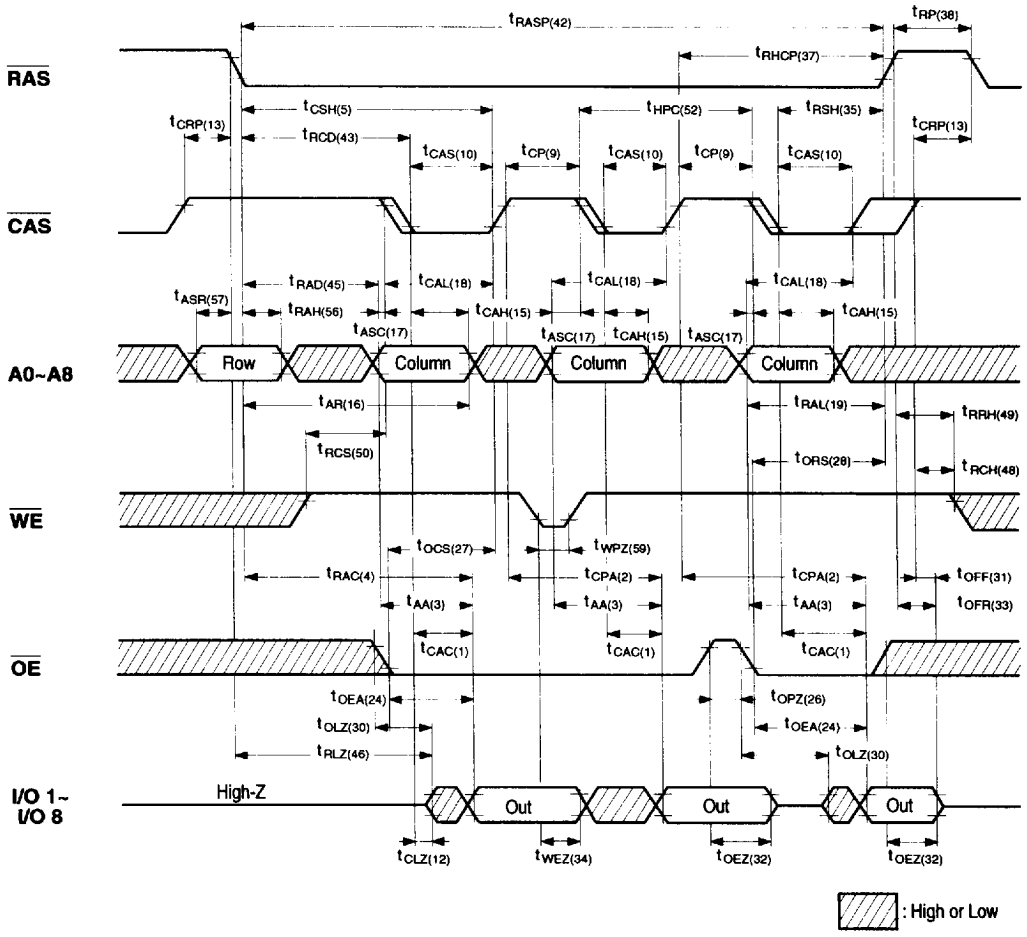
READ-MODIFY-WRITE CYCLE



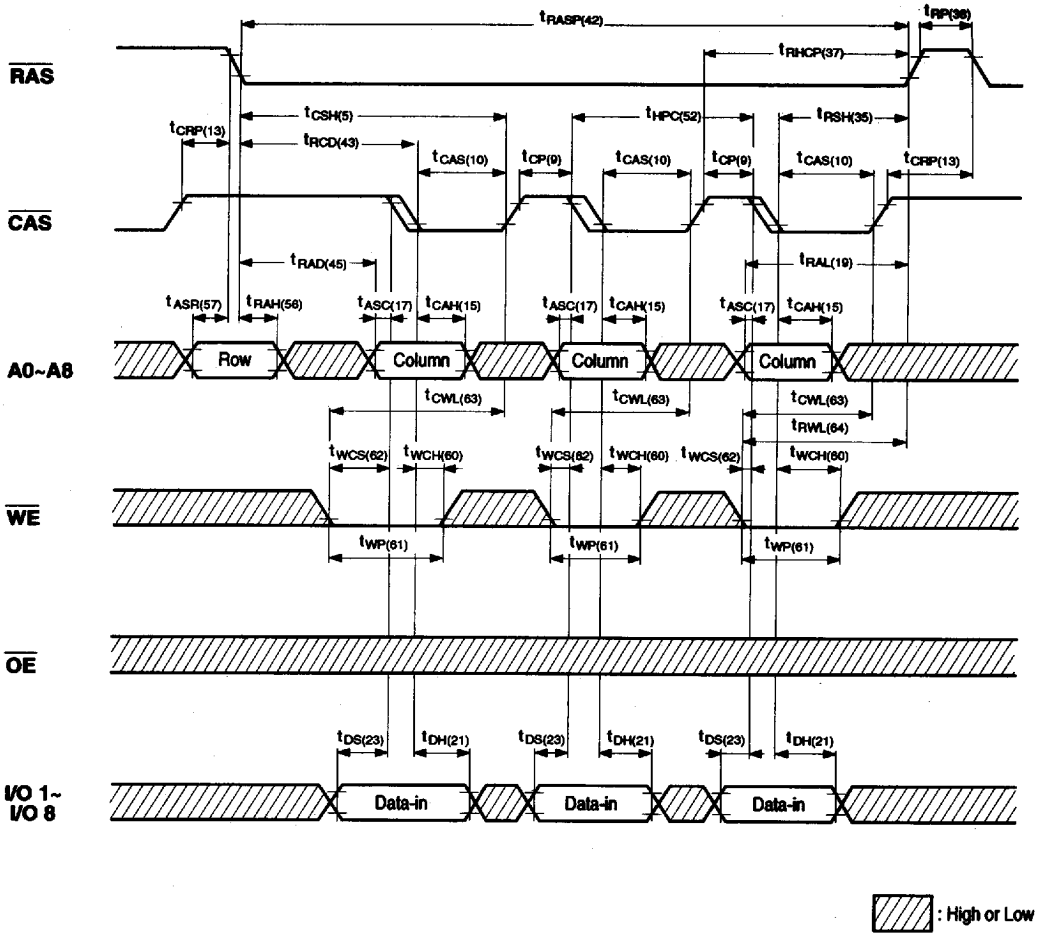
EDO (HYPER PAGE) MODE READ CYCLE



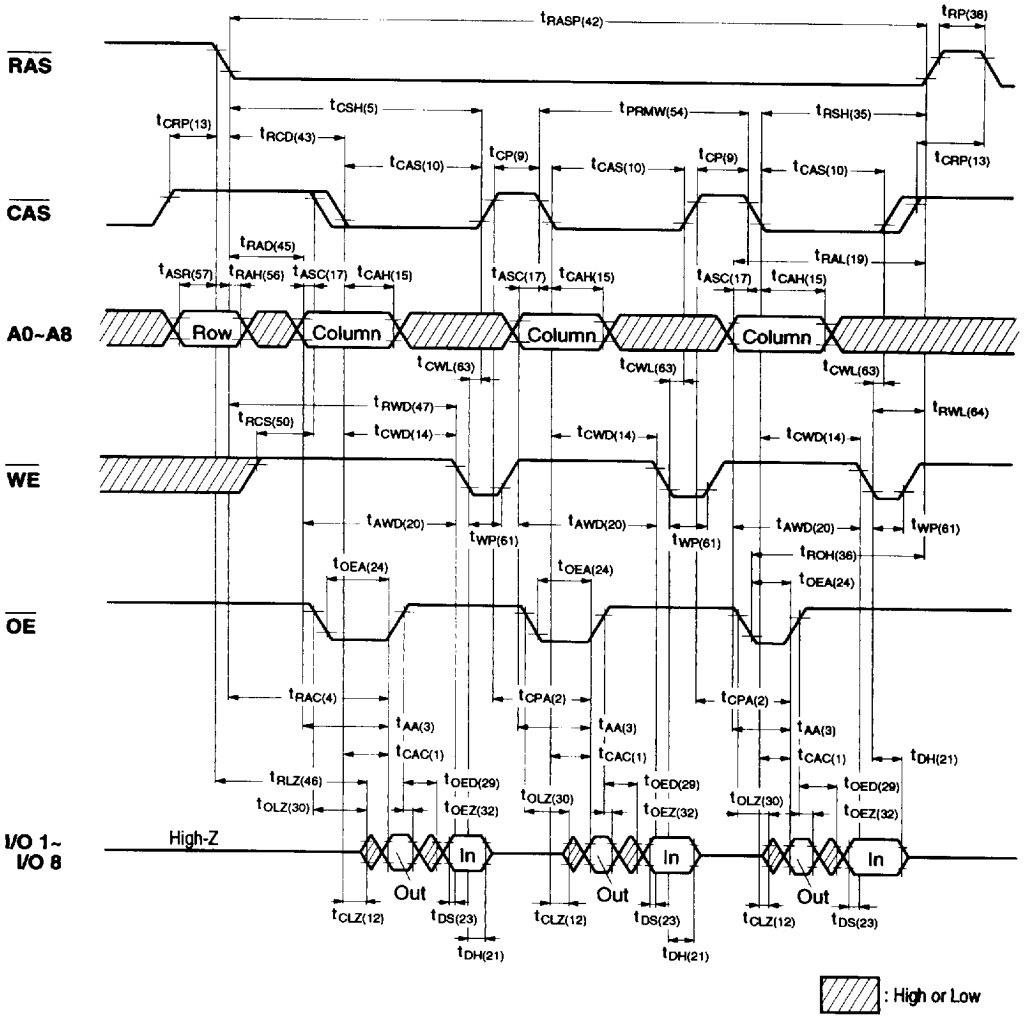
EDO (HYPER PAGE) MODE READ CYCLE ($\overline{OE}$ AND $\overline{WE}$ CONTROLLED OUTPUT)



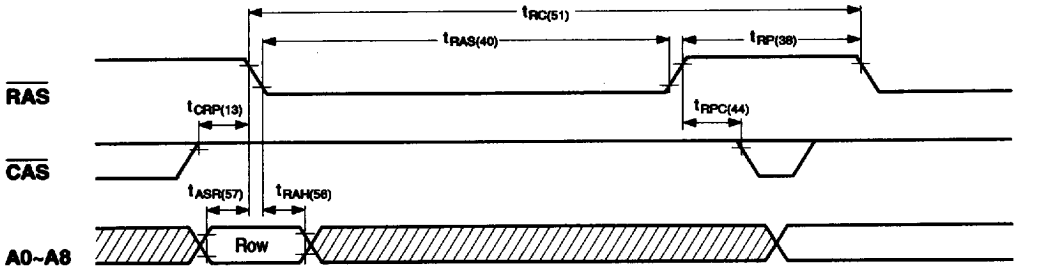
EDO (HYPER PAGE) MODE EARLY WRITE CYCLE



EDO (HYPER PAGE) MODE READ-MODIFY-WRITE CYCLE

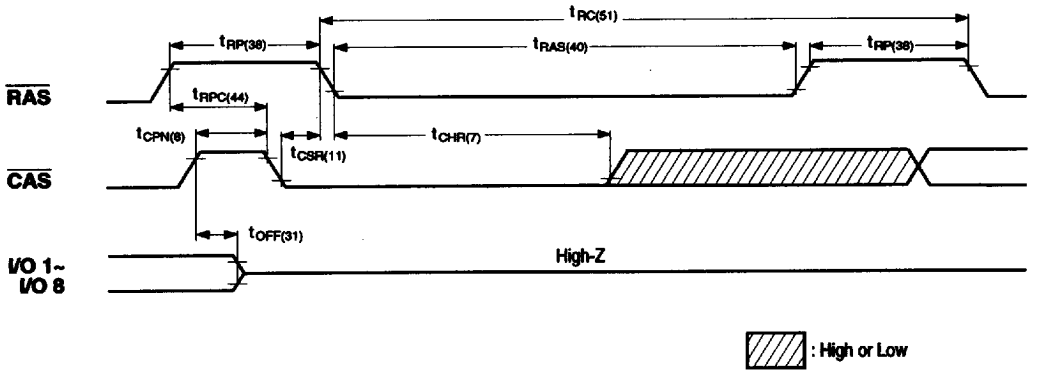


$\overline{RAS}$ ONLY REFRESH CYCLE



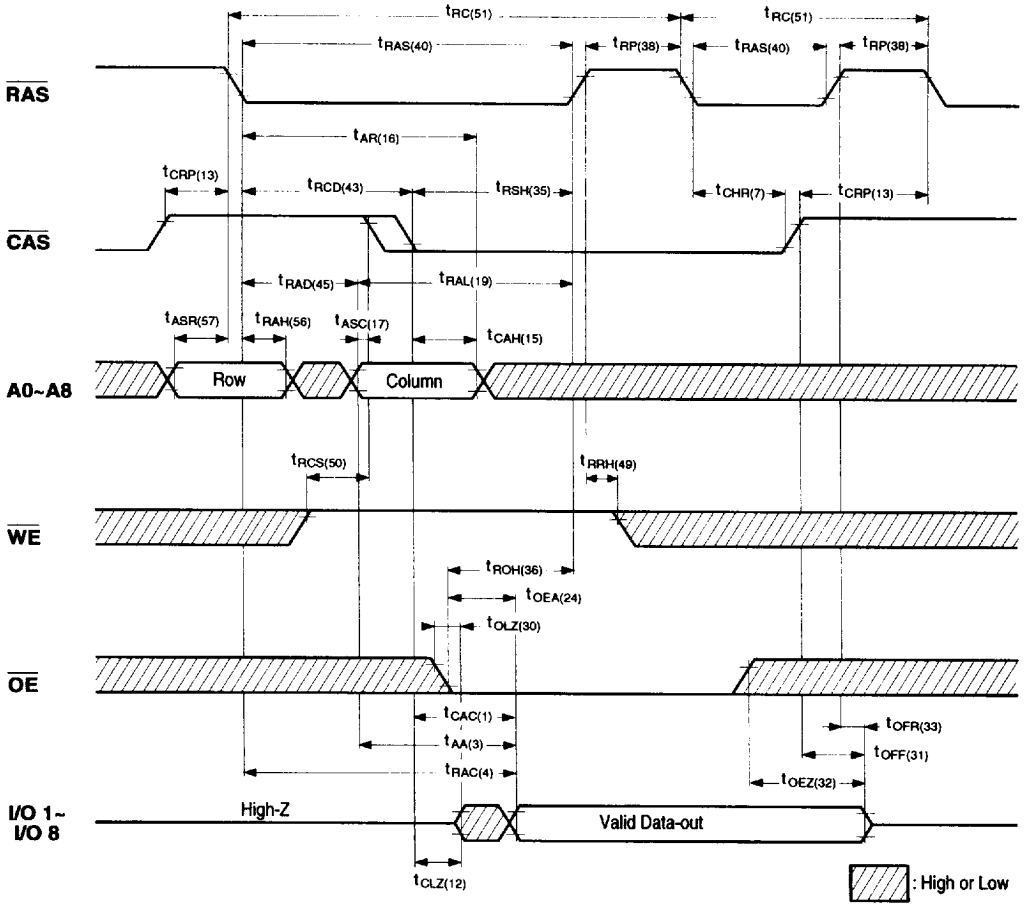
Note: $\overline{WE}$, $\overline{OE}$ = Don't care.

$\overline{CAS}$ BEFORE $\overline{RAS}$ REFRESH CYCLE

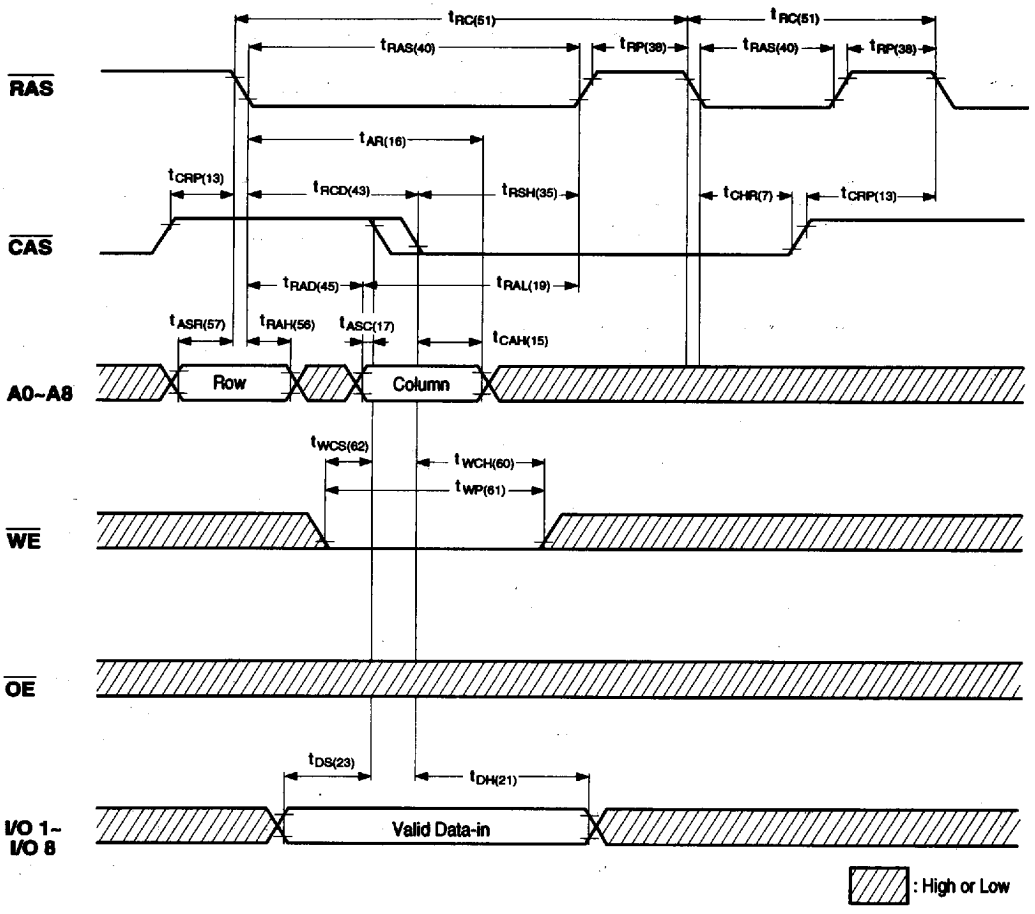


Note: $\overline{OE}$, A0~A8 = Don't care.

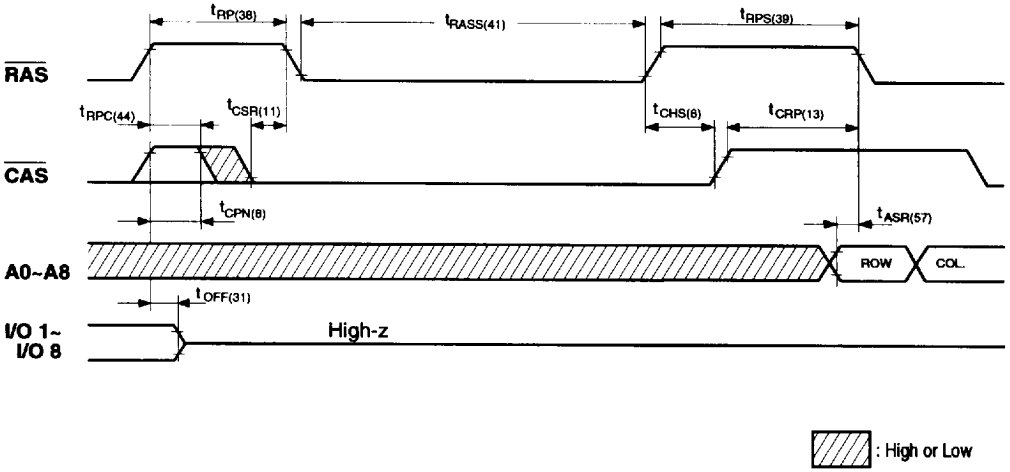
HIDDEN REFRESH CYCLE (READ)



HIDDEN REFRESH CYCLE (EARLY WRITE)



SELF REFRESH MODE



■ The NN518125 (L version) has a Self Refresh Mode.

a. Entering the Self Refresh Mode:
The NN518125L Self Refresh Mode is entered by using $\overline{CAS}$ before $\overline{RAS}$ cycle with $\overline{WE}$ " high " and holding $\overline{RAS}$ and CAS signal " low " longer than 300μs.

b. Continuing the Self Refresh Mode:
The Self Refresh Mode is continued by holding $\overline{RAS}$ " low " after entering the Self Refresh Mode.
It does not depend on $\overline{CAS}$ being " high " or " low " after entering the Self Refresh Mode for to continue the Self Refresh Mode.

c. Exiting the Self Refresh Mode:
The NN518125L exits the Self Refresh Mode when the $\overline{RAS}$ signal is brought " high ".

ORDERING INFORMATION

NN518125XJ - XX

SPEED	45	:	45ns
	50	:	50ns
	60	:	60ns
	70	:	70ns
PACKAGE	J	:	Plastic SOJ
VERSION	BLANK	:	Standard Version
	L	:	Long Refresh Version 32ms Refresh
MODE	8125	:	EDO (Hyper Page) 128K x 8