NN514265 / NN514265A series
EDO (Hyper Page) Mode
CMOS 256K × 16bit Dynamic RAM

NPNX

DESCRIPTION

The NN514265/A series is a high performance CMOS Dynamic Random Access Memory organized as 262,144 words by 16 bits. The NN514265/A 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 NN514265/A 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 NN514265/A series to be packaged in a standard 40-pin plastic SOJ,44-pin plastic TSOP TYPEII. 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

- 262,144 × 16 bit Organization
- Single 5V ±10% Power Supply
- Performance Ranges

NN514265

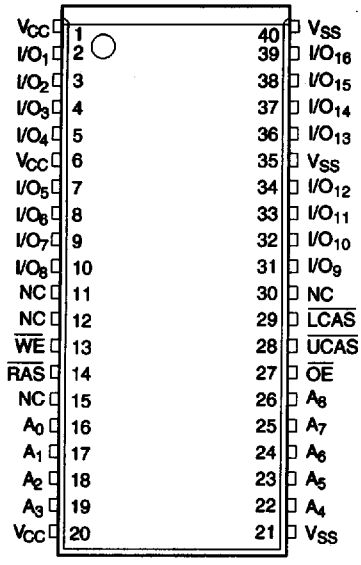
Parameter	-45	-50	-60	-70
Max. $\overline{RAS}$ Access Time (t_{RAC})	45ns	50ns	60ns	70ns
Max. $\overline{CAS}$ Access Time (t_{CAC})	15ns	15ns	15ns	20ns
Max. Column Address Access Time (t_{AA})	23ns	25ns	30ns	35ns
Min. Read/Write Cycle Time (t_{RC})	80ns	90ns	110ns	130ns

NN514265A

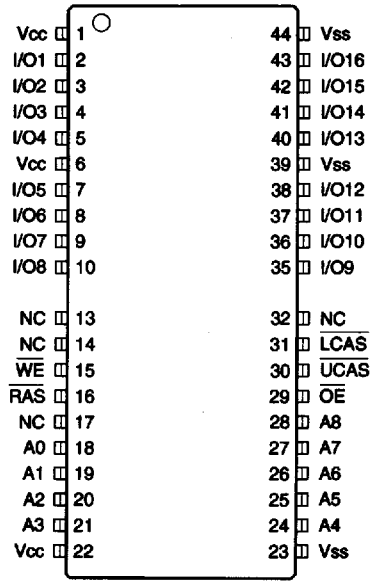
Parameter	-35	-40	-45	-50	-60
Max. $\overline{RAS}$ Access Time (t_{RAC})	35ns	40ns	45ns	50ns	60ns
Max. $\overline{CAS}$ Access Time (t_{CAC})	10ns	10ns	13ns	13ns	15ns
Max. Column Address Access Time (t_{AA})	19ns	21ns	23ns	25ns	30ns
Min. Read/Write Cycle Time (t_{RC})	60ns	75ns	80ns	84ns	104ns

- EDO (Hyper Page) Mode Operation
- Separate $\overline{CAS}$ ($\overline{UCAS}$, $\overline{LCAS}$) for Byte Selection
- Byte Read/Write Mode Operation
- Low Power Operation
  Low Standby Current (CMOS level inputs)
  – Standard 1mA
  – L version 100µA
- 512 Refresh Cycles
  – Standard distributed across 8ms
  – L version distributed across 128ms
- 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 Package
  Plastic 40pin SOJ (P40SJ-2B)
  Plastic 44pin TSOP TYPEII (P44/40TP-3B)
  (P44/40TP-3B-L)*
  *Note: Only for NN514265A

PIN CONFIGURATION (TOP VIEW)



40-pin SOJ (400mil)
P40SJ-2B



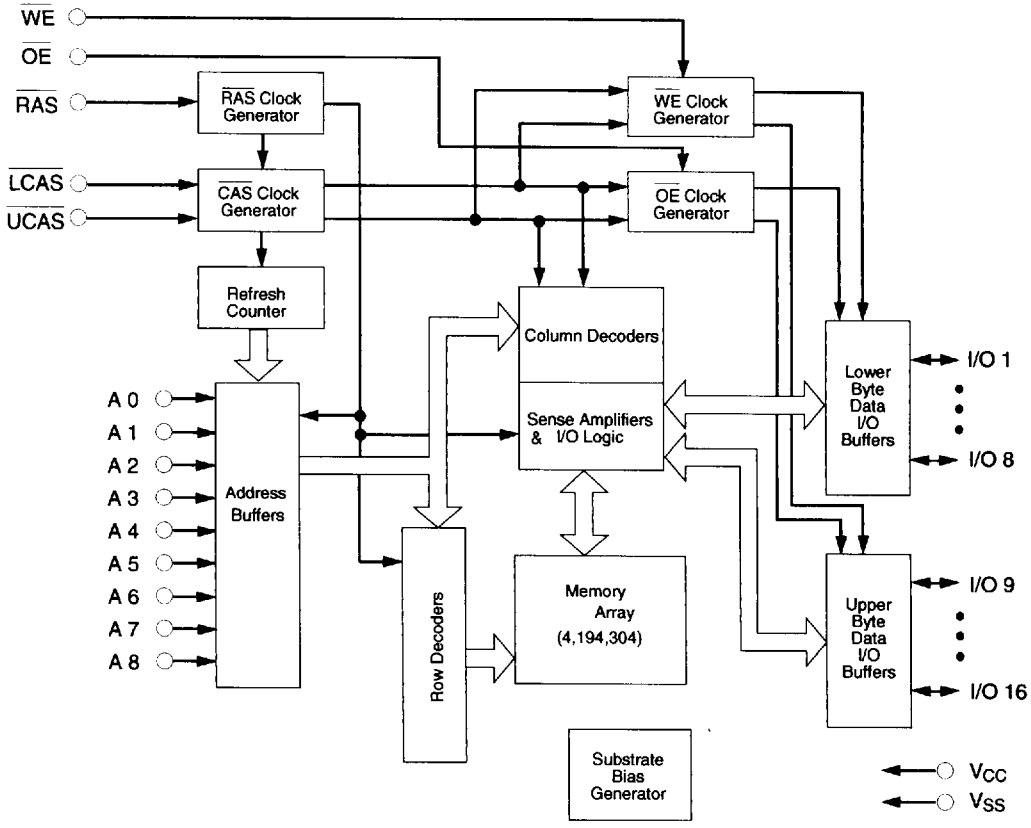
44/40-pin TSOP TYPE (II)
(400mil)
P44/40TP-3B
P44/40TP-3B-L*

*Note: Only for NN514265A

PIN NAMES

A0~A8	Address Inputs
$\overline{RAS}$	Row Address Strobe
$\overline{UCAS}$	Column Address Strobe Upper Byte Control
$\overline{LCAS}$	Column Address Strobe Lower Byte Control
$\overline{OE}$	Output Enable
I/O1~I/O16	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	−0.5	—	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%)
(NN514265)

SYMBOL	PARAMETER	SPEED	MIN.	MAX.	UNIT	TEST CONDITIONS	NOTES
I_{CC1}	Operating Current	-45 -50 -60 -70		180 160 150 130	mA mA mA mA	t_{RC} = t_{RC} (min.) $\overline{RAS}$, $\overline{CAS}$, Address cycling	1, 2
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)			100	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 -50 -60 -70		180 160 150 130	mA mA mA mA	t_{RC} = t_{RC} (min.) $\overline{RAS}$ cycling, $\overline{CAS}$ = V_{IH}	1
I_{CC4}	EDO (Hyper Page) Mode Current	-45 -50 -60 -70		125 120 110 100	mA mA mA mA	t_{HPC} = t_{HPC} (min.) $\overline{RAS}$ = V_{IL} $\overline{CAS}$, Address cycling	1,2
I_{CC5}	Refresh Current ($\overline{CAS}$ before $\overline{RAS}$ refresh)	-45 -50 -60 -70		180 160 150 130	mA mA mA mA	t_{RC} = t_{RC} (min.) $\overline{RAS}$, $\overline{CAS}$ cycling	1
I_{CC6}	Refresh Current (L version : $\overline{CAS}$ before $\overline{RAS}$ refresh)			150	µA	512 cycles / 128ms 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)			150	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_{IN} ≤ 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}	$\overline{RAS}$, $\overline{UCAS}$, $\overline{LCAS}$, $\overline{WE}$,$\overline{OE}$	—	5	pF
C_{OUT}	I/O1~I/O16	—	7	pF

DC ELECTRICAL CHARACTERISTICS (0°C ≤ Ta ≤ 70°C, V_{CC} = 5.0V ±10%)
(NN514265A)

SYMBOL	PARAMETER	SPEED	MIN.	MAX.	UNIT	TEST CONDITIONS	NOTES
I_{CC1}	Operating Current	-35		180	mA	t_{RC} = t_{RC} (min.)	1, 2
		-40		160	mA	$\overline{RAS}$, $\overline{CAS}$, Address cycling	
		-45		140	mA		
		-50		120	mA		
		-60		100	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)			150	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)	-35		180	mA	t_{RC} = t_{RC} (min.)	1
		-40		160	mA	$\overline{RAS}$ cycling, $\overline{CAS}$ = V_{IH}	
		-45		140	mA		
		-50		120	mA		
		-60		100	mA		
I_{CC4}	EDO (Hyper Page) Mode Current	-35		110	mA	t_{HPC} = t_{HPC} (min.)	1,2
		-40		100	mA	$\overline{RAS}$ = V_{IL}	
		-45		90	mA	$\overline{CAS}$, Address cycling	
		-50		80	mA		
		-60		70	mA		
I_{CC5}	Refresh Current ($\overline{CAS}$ before $\overline{RAS}$ refresh)	-35		180	mA	t_{RC} = t_{RC} (min.)	1
		-40		160	mA	$\overline{RAS}$, $\overline{CAS}$ cycling	
		-45		140	mA		
		-50		120	mA		
		-60		100	mA		
I_{CC6}	Refresh Current (L version : $\overline{CAS}$ before $\overline{RAS}$ refresh)			200	µA	512 cycles / 128ms 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)			200	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}	$\overline{RAS}$, $\overline{UCAS}$, $\overline{LCAS}$, $\overline{WE}$,$\overline{OE}$	—	5	pF
C_{OUT}	I/O1~I/O16	—	7	pF

AC ELECTRICAL CHARACTERISTICS

Test conditions : V_{IH} / V_{IL} = 2.4V / 0.8V V_{OH} / V_{OL} = 2.0V / 0.8V output loading C_L = 100pF + 2TTL

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

(NN514265)

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	—	28	—	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	—	40	—	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)	8	—	8	—	10	—	10	—	ns	
8	t_{CH2CL2}	t_{CPN}	$\overline{CAS}$ Precharge Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	8	—	8	—	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	35	—	35	—	35	—	50	—	ns	11
15	t_{CL1AX}	t_{CAH}	Column Address Hold Time	8	—	8	—	10	—	15	—	ns	
16	t_{RL1AX}	t_{AR}	Column Address Hold Time Referenced to $\overline{RAS}$	30	—	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	22	—	24	—	30	—	35	—	ns	
20	t_{AVWL2}	t_{AWD}	Column Address to $\overline{WE}$ Delay Time	48	—	50	—	50	—	65	—	ns	11
21	t_{CL1DX} t_{WL1DX}	t_{DH}	Data Hold Time	8	—	8	—	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	—	13	—	13	—	15	—	20	ns	
25	t_{WL1OL2}	t_{OEH}	$\overline{OE}$ Command Hold Time	13	—	13	—	15	—	20	—	ns	
26	t_{GH2GL2}	t_{OPZ}	$\overline{OE}$ Pulse Width for Output Disable When $\overline{CAS}$ High	5	—	7	—	7	—	7	—	ns	
27	t_{GL1CH1}	t_{OCS}	$\overline{OE}$ Setup Time to $\overline{CAS}$ High	5	—	7	—	7	—	7	—	ns	
28	t_{GL1RH1}	t_{ORS}	$\overline{OE}$ Setup Time to $\overline{RAS}$ High	5	—	7	—	7	—	7	—	ns	
29	t_{CH2QV}	t_{OED}	$\overline{OE}$ to Data Delay Time	7	—	8	—	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	12	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	
33	t_{RHQZ}	t_{OFR}	Output Buffer Turn-off Delay Time Referenced to $\overline{RAS}$	0	12	0	13	0	15	0	15	ns	16

NO.	SYMBOL		PARAMETER	-45		-50		-60		-70		UNIT	NOTE
	JEDEC	STD.		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
34	t_{WL2QZ}	t_{WEZ}	Output Buffer Turn-off Delay Time Referenced to $\overline{WE}$	0	12	0	13	0	15	0	15	ns	
35	t_{CL1RH1}	t_{RSH}	$\overline{RAS}$ Hold Time	13	—	13	—	15	—	20	—	ns	
36	t_{OL1RH1}	t_{ROH}	$\overline{RAS}$ Hold Time Referenced to $\overline{OE}$	8	—	8	—	10	—	10	—	ns	
37	t_{CH2RH1}	t_{RHCP}	$\overline{RAS}$ Hold Time Referenced $\overline{CAS}$ Precharge	28	—	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)	80	—	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	20	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	60	—	65	—	75	—	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 $\overline{RAS}$	5	—	5	—	5	—	5	—	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	80	—	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	120	—	125	—	135	—	185	—	ns	
54	t_{CL2CL2}	t_{PRMW}	Read-Modify-Write Cycle Time (EDO (Hyper Page) Mode)	57	—	57	—	66	—	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	5	—	7	—	7	—	7	—	ns	
60	t_{CL1WH1}	t_{WCH}	Write Command Hold Time	8	—	8	—	10	—	15	—	ns	
61	t_{WL1WH1}	t_{WP}	Write Command Pulse Width	8	—	8	—	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	8	—	8	—	15	—	20	—	ns	
64	t_{WL1RH1}	t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	8	—	8	—	10	—	20	—	ns	

A.C. ELECTRICAL CHARACTERISTICS

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

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

(NN514265A)

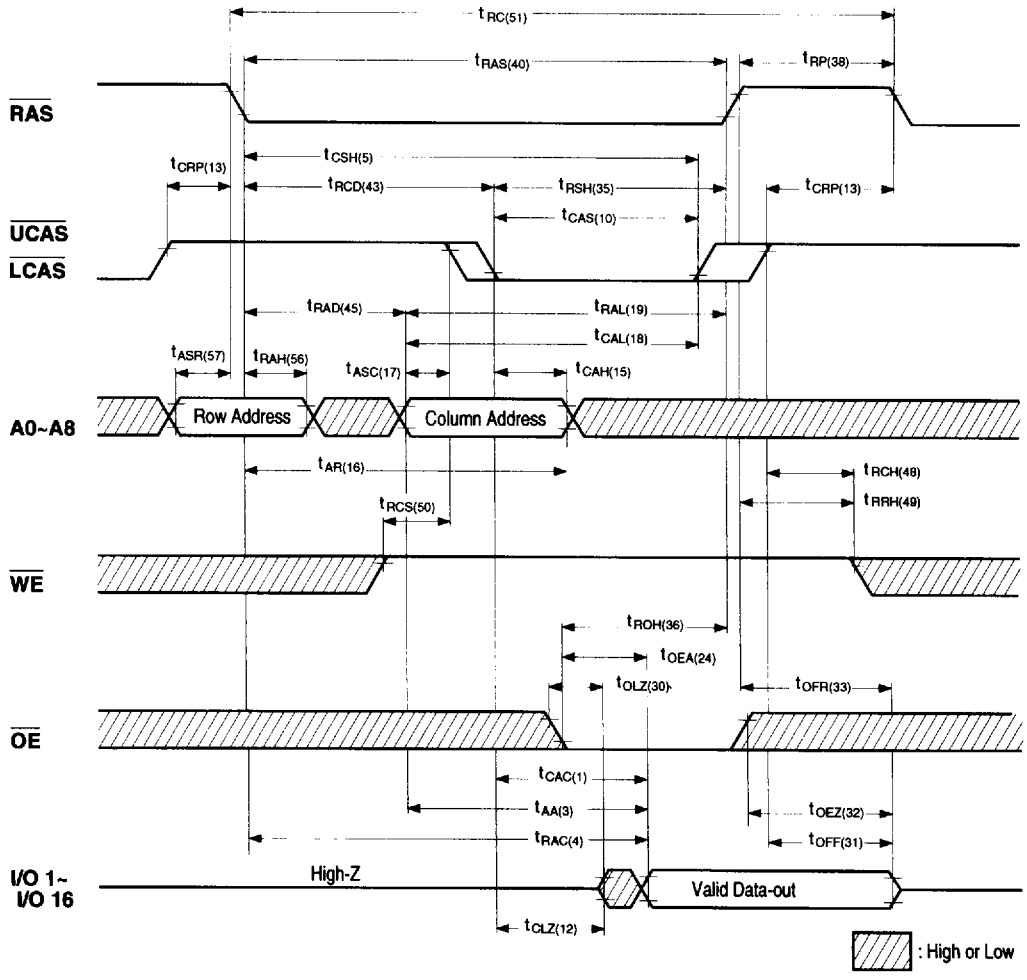
NO.	NOTES		PARAMETER	-35		-40		-45		-50		-60		UNIT	NOTE
	JEDEC	STD.		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
1	t_{CL1QV}	t_{CAC}	Access Time from $\overline{CAS}$	—	10	—	10	—	15	—	15	—	15	ns	6,13
2	t_{CH2QV}	t_{CPA}	Access Time from $\overline{CAS}$ Precharge	—	21	—	23	—	28	—	30	—	35	ns	13,14
3	t_{AVQV}	t_{AA}	Access Time from Column Address	—	19	—	21	—	23	—	25	—	30	ns	7,13
4	t_{RL1QV}	t_{RAC}	Access Time from $\overline{RAS}$	—	35	—	40	—	45	—	50	—	60	ns	6,7
5	t_{RL1CH1}	t_{CSH}	$\overline{CAS}$ Hold Time	27	—	30	—	30	—	35	—	40	—	ns	
6	t_{RL1CX}	t_{CHS}	$\overline{CAS}$ Hold Time (Self Refresh Mode)	-50	—	-50	—	-50	—	-50	—	-50	—	ns	
7	t_{RL1CH1}	t_{CHR}	$\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	8	—	8	—	8	—	8	—	10	—	ns	
8	t_{CH2CL2}	t_{CPN}	$\overline{CAS}$ Precharge Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	5	—	7	—	8	—	8	—	10	—	ns	
9	t_{CH2CL2}	t_{CP}	$\overline{CAS}$ Precharge Time (EDO (Hyper Page) Mode)	5	—	5	—	5	—	5	—	5	—	ns	14
10	t_{CL1CH1}	t_{CAS}	$\overline{CAS}$ Pulse Width	6	100K	6	100K	8	100K	8	100K	10	100K	ns	
11	t_{CL1RL2}	t_{CSR}	$\overline{CAS}$ Setup Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	5	—	5	—	5	—	5	—	5	—	ns	
12	t_{CL1QX}	t_{CLZ}	$\overline{CAS}$ to Output in Low-Z	0	—	0	—	0	—	0	—	0	—	ns	8
13	t_{CH2RL2}	t_{CRP}	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5	—	5	—	5	—	5	—	5	—	ns	
14	t_{CL1WL2}	t_{CWD}	$\overline{CAS}$ to $\overline{WE}$ Delay Time	20	—	20	—	35	—	35	—	35	—	ns	11
15	t_{CL1AX}	t_{CAH}	Column Address Hold Time	6	—	6	—	8	—	8	—	10	—	ns	
16	t_{RL1AX}	t_{AR}	Column Address Hold Time Referenced to $\overline{RAS}$	25	—	28	—	30	—	35	—	40	—	ns	
17	t_{AVCL2}	t_{ASC}	Column Address Setup Time	0	—	0	—	0	—	0	—	0	—	ns	14
18	t_{AVCH1}	t_{CAL}	Column Address to $\overline{CAS}$ Lead Time	9	—	11	—	13	—	13	—	18	—	ns	
19	t_{AVRH1}	t_{RAL}	Column Address to $\overline{RAS}$ Lead Time	18	—	20	—	22	—	24	—	30	—	ns	
20	t_{AVWL2}	t_{AWD}	Column Address to $\overline{WE}$ Delay Time	29	—	31	—	48	—	50	—	50	—	ns	11
21	t_{CL1DX} t_{WL1DX}	t_{DH}	Data Hold Time	6	—	6	—	8	—	8	—	10	—	ns	12
22	t_{CL2QX}	t_{DHC}	Data Output Hold Time (EDO (Hyper Page) Mode)	0	—	0	—	0	—	0	—	0	—	ns	
23	t_{DVCL2} t_{DVWL2}	t_{DS}	Data Setup Time	0	—	0	—	0	—	0	—	0	—	ns	12
24	t_{OL1QV}	t_{OEA}	$\overline{OE}$ Access Time	—	10	—	10	—	13	—	13	—	15	ns	
25	t_{WL1OL2}	t_{OEH}	$\overline{OE}$ Command Hold Time	5	—	5	—	13	—	13	—	15	—	ns	
26	t_{GH2GL2}	t_{OPZ}	$\overline{OE}$ Pulse Width for Output Disable When $\overline{CAS}$ High	5	—	5	—	5	—	7	—	7	—	ns	
27	t_{GL1CH1}	t_{OCS}	$\overline{OE}$ Setup Time to $\overline{CAS}$ High	5	—	5	—	5	—	7	—	7	—	ns	
28	t_{GL1RH1}	t_{ORS}	$\overline{OE}$ Setup Time to $\overline{RAS}$ High	5	—	5	—	5	—	7	—	7	—	ns	
29	t_{CH2QV}	t_{OED}	$\overline{OE}$ to Data Delay Time	5	—	6	—	7	—	8	—	10	—	ns	
30	t_{GL2QX}	t_{OLZ}	$\overline{OE}$ to Output in low-Z	0	—	0	—	0	—	0	—	0	—	ns	
31	t_{CH2QZ}	t_{OFF}	Output Buffer Turn-off Delay Time	0	8	0	10	0	12	0	13	0	15	ns	10
32	t_{OH2QX}	t_{OEZ}	Output Buffer Turn-off Delay Time Referenced to $\overline{OE}$	0	8	0	8	0	10	0	10	0	15	ns	

NO.	SYMBOL		PARAMETER	-35		-40		-45		-50		-60		UNIT	NOTE
	JEDEC	STD.		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
33	t_{RHQZ}	t_{OFR}	Output Buffer Turn-off Delay Time Referenced to $\overline{RAS}$	0	8	0	10	0	12	0	13	0	15	ns	16
34	t_{WL2QZ}	t_{WEZ}	Output Buffer Turn-off Delay Time Referenced to $\overline{WE}$	0	12	0	12	0	12	0	13	0	15	ns	
35	t_{CL1RH1}	t_{RSH}	$\overline{RAS}$ Hold Time	8	—	8	—	13	—	13	—	15	—	ns	
36	t_{OL1RH1}	t_{ROH}	$\overline{RAS}$ Hold Time Referenced to $\overline{OE}$	7	—	8	—	8	—	8	—	10	—	ns	
37	t_{CH2RH1}	t_{RHCP}	$\overline{RAS}$ Hold Time Referenced $\overline{CAS}$ Precharge	24	—	26	—	28	—	30	—	35	—	ns	
38	t_{RH2RL2}	t_{RP}	$\overline{RAS}$ Precharge Time	20	—	25	—	25	—	25	—	30	—	ns	
39	t_{RH2RL2}	t_{RPS}	$\overline{RAS}$ Precharge Time (Self Refresh Mode)	60	—	70	—	80	—	90	—	110	—	ns	
40	t_{RL1RH1}	t_{RAS}	$\overline{RAS}$ Pulse Width	35	100K	40	100K	45	100K	50	100K	60	100K	ns	
41	t_{RL1RH1}	t_{RASS}	$\overline{RAS}$ Pulse Width (Self Refresh Mode)	300	—	300	—	300	—	300	—	300	—	µs	
42	t_{RL1RH1}	t_{RASP}	$\overline{RAS}$ Pulse Width (EDO (Hyper Page) Mode)	35	100K	40	100K	45	100K	50	100K	60	100K	ns	
43	t_{RL1CL1}	t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	11	25	12	30	13	30	13	35	13	45	ns	6
44	t_{RH2CL2}	t_{RPC}	$\overline{RAS}$ to $\overline{CAS}$ Precharge Time	0	—	0	—	10	—	10	—	10	—	ns	
45	t_{RL1AV}	t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	9	16	10	19	11	20	11	23	11	30	ns	7
46	t_{RL2QX}	t_{RLZ}	$\overline{RAS}$ To Output in Low-Z	0	—	0	—	0	—	0	—	0	—	ns	
47	t_{RL1WL2}	t_{RWD}	$\overline{RAS}$ to $\overline{WE}$ Delay Time	45	—	50	—	60	—	65	—	75	—	ns	11
48	t_{CH2WL2}	t_{RCH}	Read Command Hold Time	0	—	0	—	0	—	0	—	0	—	ns	9
49	t_{RH2WL2}	t_{RRH}	Read Command Hold Time Referenced to $\overline{RAS}$	5	—	5	—	5	—	5	—	5	—	ns	9
50	t_{WH2CL2}	t_{RCS}	Read Command Setup Time	0	—	0	—	0	—	0	—	0	—	ns	
51	t_{RL2RL2}	t_{RC}	Random Read or Write Cycle Time	60	—	75	—	80	—	84	—	104	—	ns	
52	t_{CL2CL2}	t_{HPC}	Read or Write Cycle Time (EDO (Hyper Page) Mode)	13	—	15	—	20	—	20	—	25	—	ns	13,14
53	t_{RL2RL2}	t_{RMW}	Read-Modify-Write Cycle Time	80	—	100	—	120	—	125	—	135	—	ns	
54	t_{CL2CL2}	t_{PRMW}	Read-Modify-Write Cycle Time (EDO (Hyper Page) Mode)	52	—	55	—	57	—	57	—	66	—	ns	13,14
55	t_{REF}	t_{REF}	Refresh Period	—	8	—	8	—	8	—	8	—	8	ms	15
56	t_{RL1AX}	t_{RAH}	Row Address Hold Time	7	—	8	—	8	—	8	—	8	—	ns	
57	t_{AVRL2}	t_{ASR}	Row Address Setup Time	0	—	0	—	0	—	0	—	0	—	ns	
58	t_T	t_T	Transition Time (Rise and Fall)	2	50	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	5	—	5	—	5	—	7	—	7	—	ns	
60	t_{CL1WH1}	t_{WCH}	Write Command Hold Time	6	—	6	—	8	—	8	—	10	—	ns	
61	t_{WL1WH1}	t_{WP}	Write Command Pulse Width	6	—	6	—	8	—	8	—	10	—	ns	
62	t_{WL1CL2}	t_{WCS}	Write Command Setup Time	0	—	0	—	0	—	0	—	0	—	ns	11
63	t_{WL1CH1}	t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	6	—	6	—	8	—	8	—	15	—	ns	
64	t_{WL1RH1}	t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	8	—	8	—	8	—	8	—	10	—	ns	

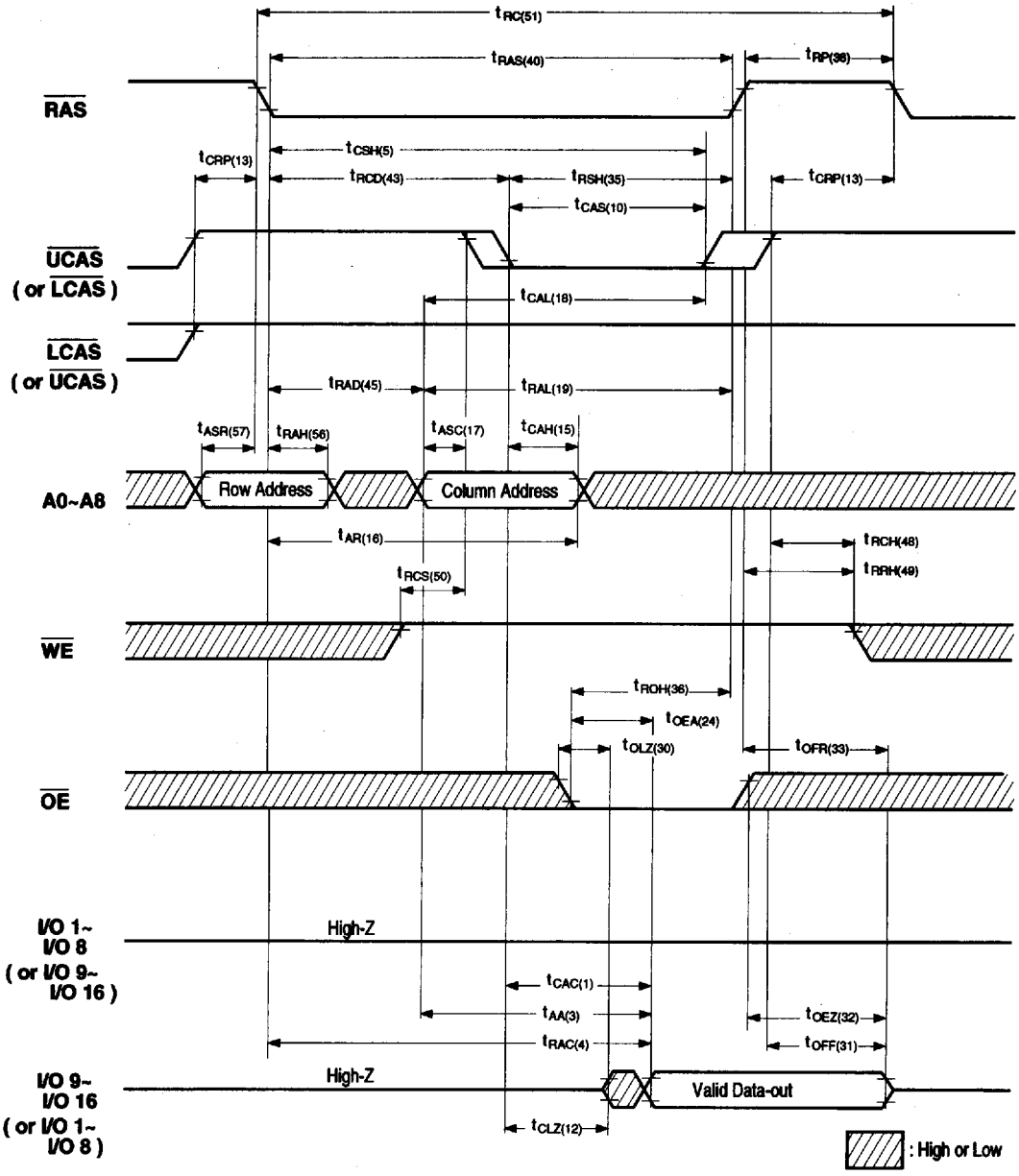
Notes:

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.
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.
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 $t_{WCS} \geq t_{WCS}$(min.) , the cycle is an early write cycle and data-out pins will remain open circuit (high impedance) throughout the entire cycle. If $t_{RWD} \geq t_{RWD}$(min.), $t_{CWD} \geq t_{CWD}$(min.) and $t_{AWD} \geq t_{AWD}$(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. $t_{ASC} \geq t_{CP}$ to achieve t_{PC}(min.) and t_{CPA}(max.) values.
15. t_{REF}=128msec for Long Refresh version (L version).
16. t_{OFR} applies only when $\overline{CAS}$ is high.

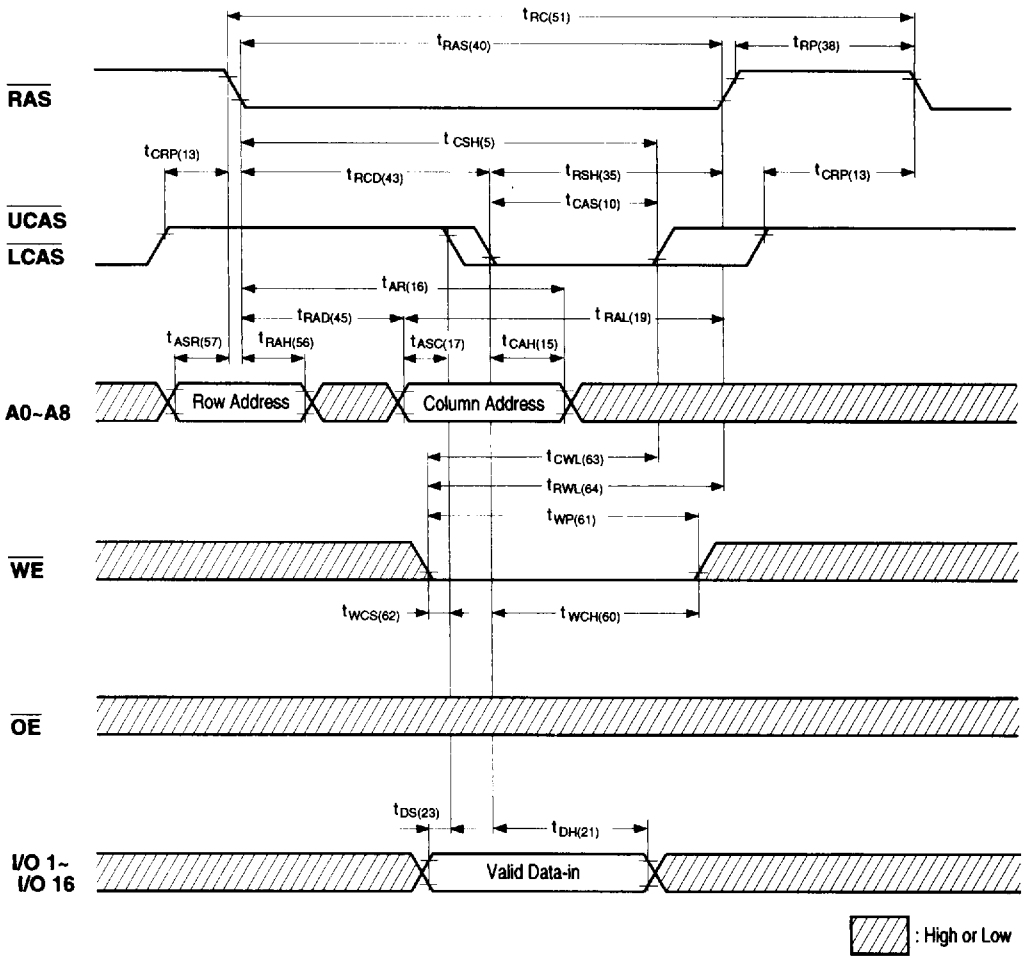
WORD READ CYCLE



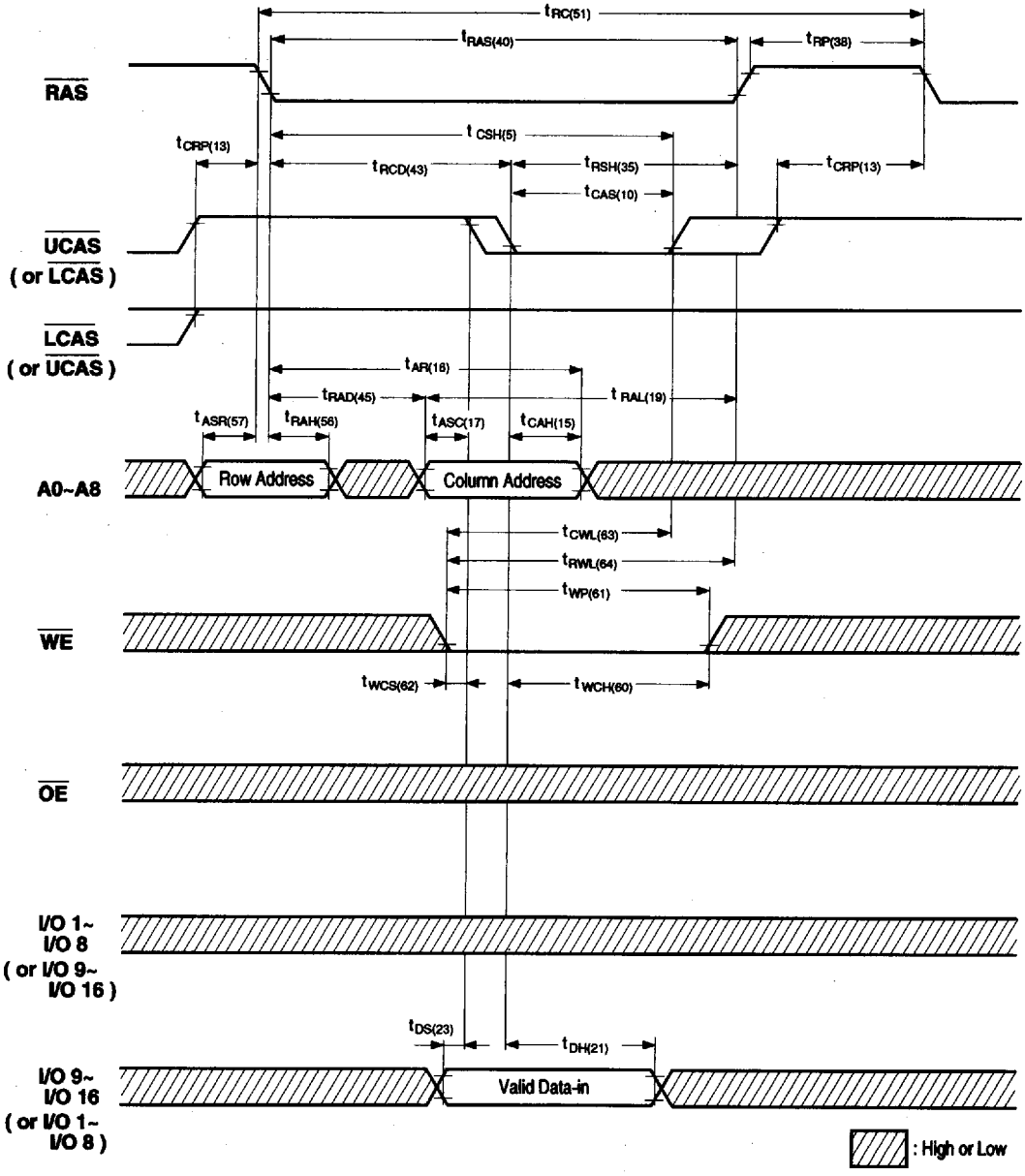
BYTE READ CYCLE



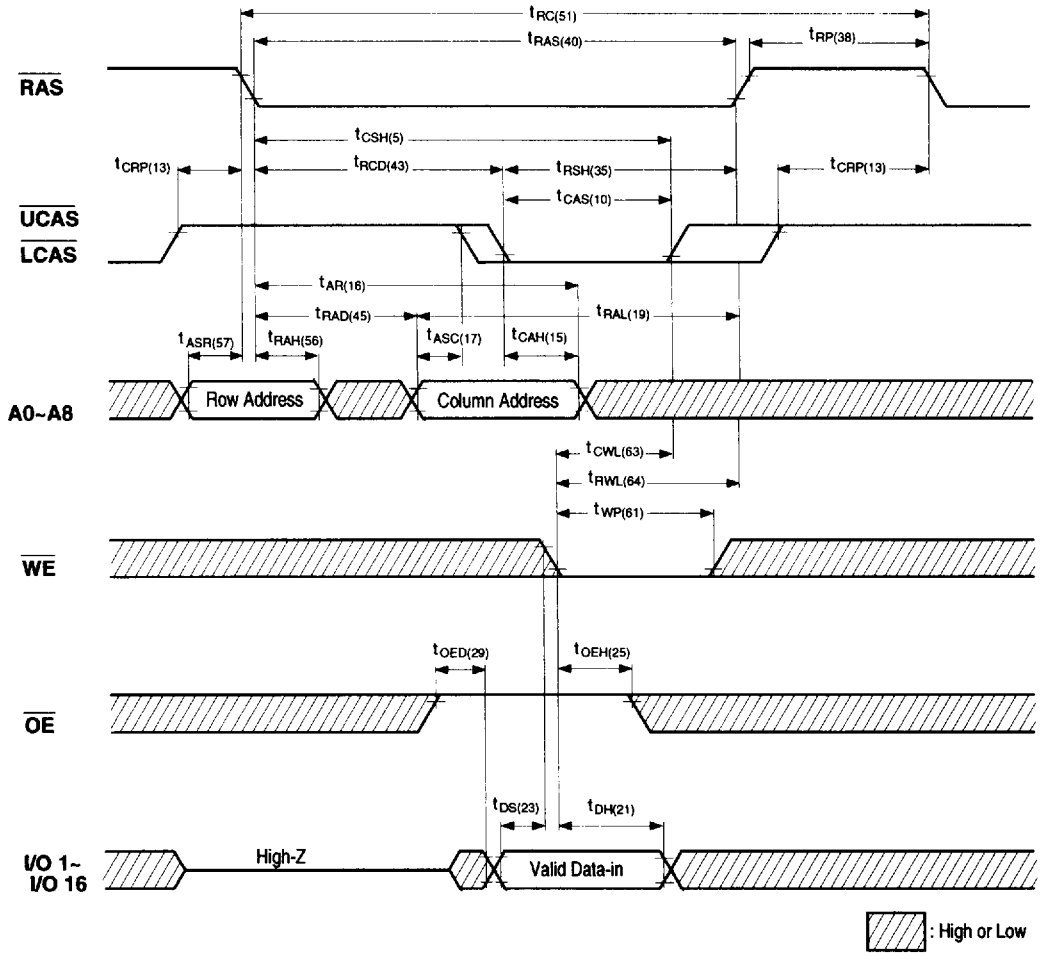
WORD WRITE CYCLE (EARLY WRITE)



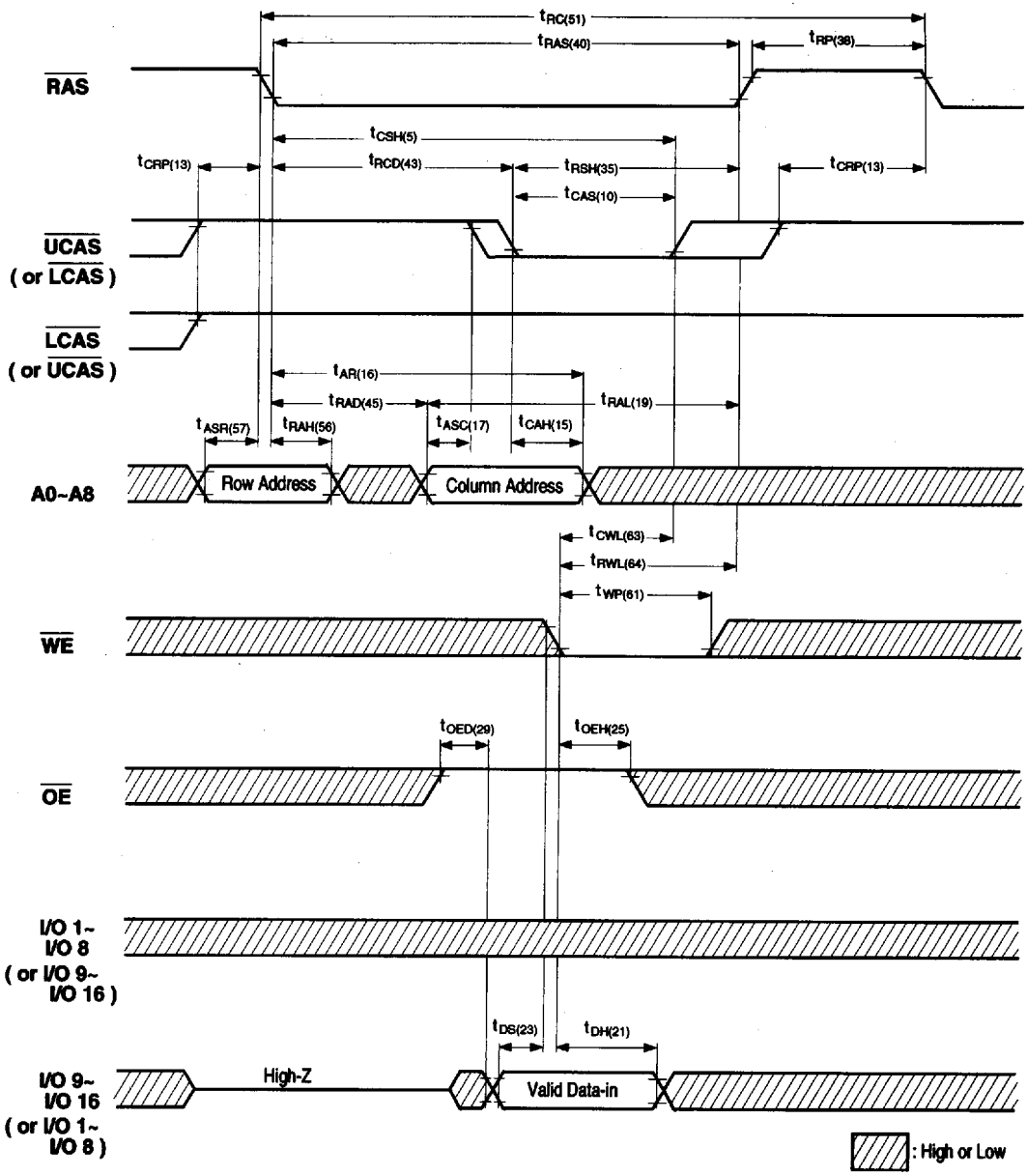
BYTE WRITE CYCLE (EARLY WRITE)



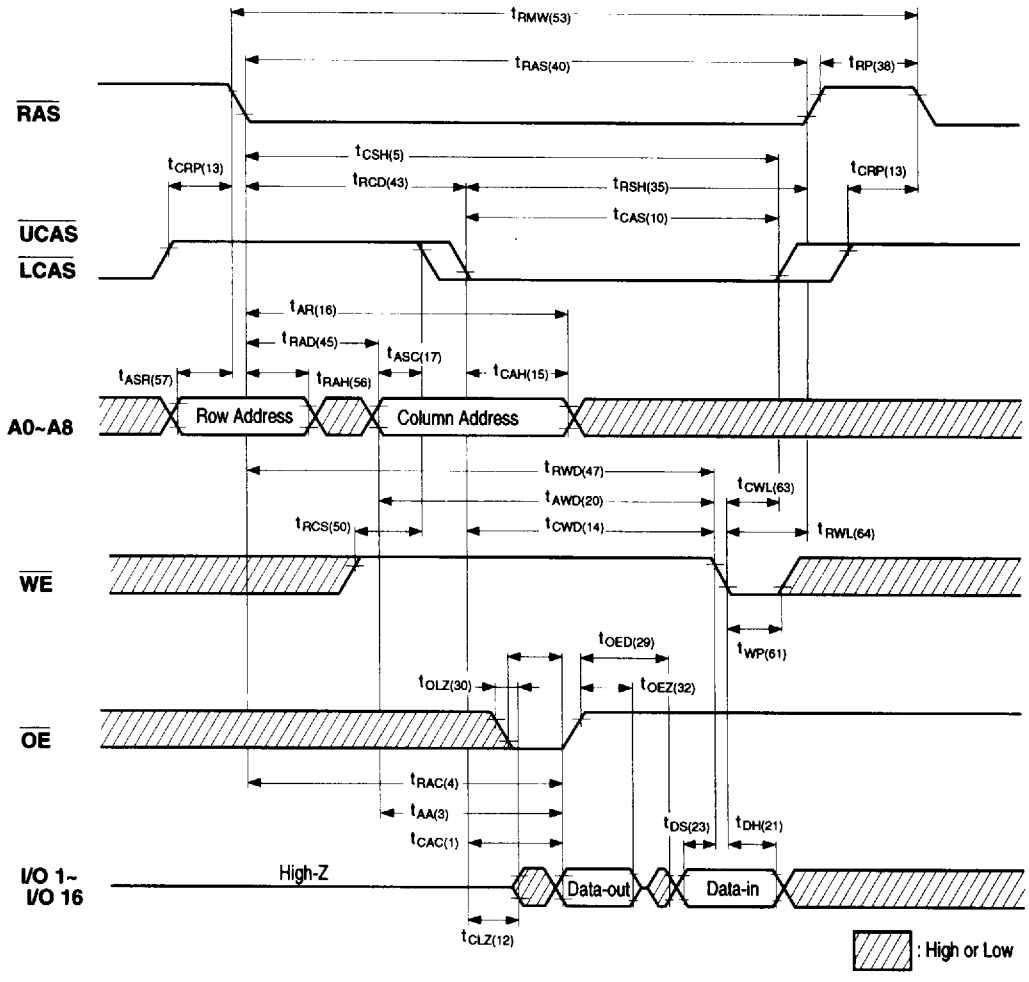
WORD WRITE CYCLE ($\overline{OE}$-CONTROLLED WRITE)



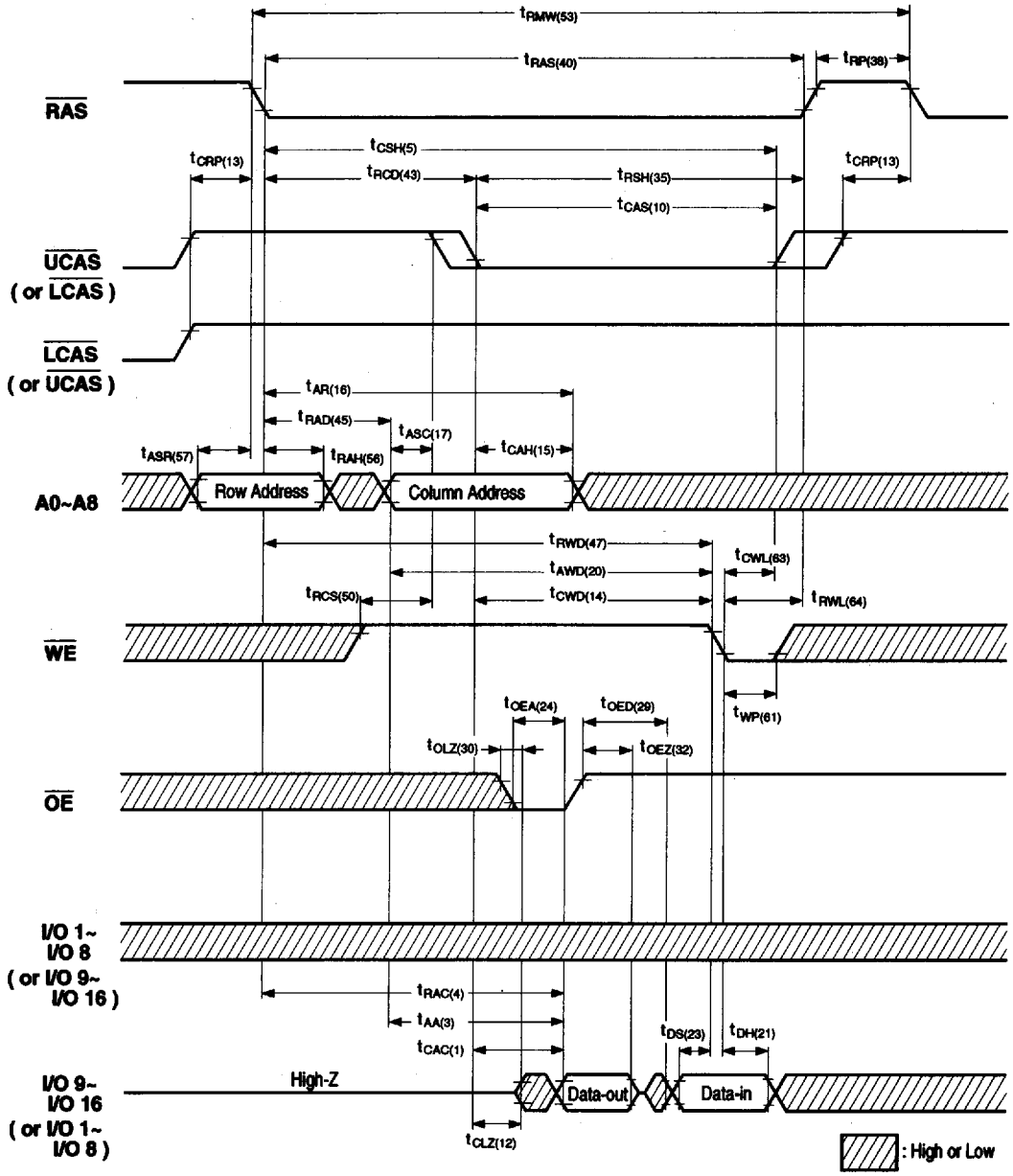
BYTE WRITE CYCLE (OE-CONTROLLED WRITE)



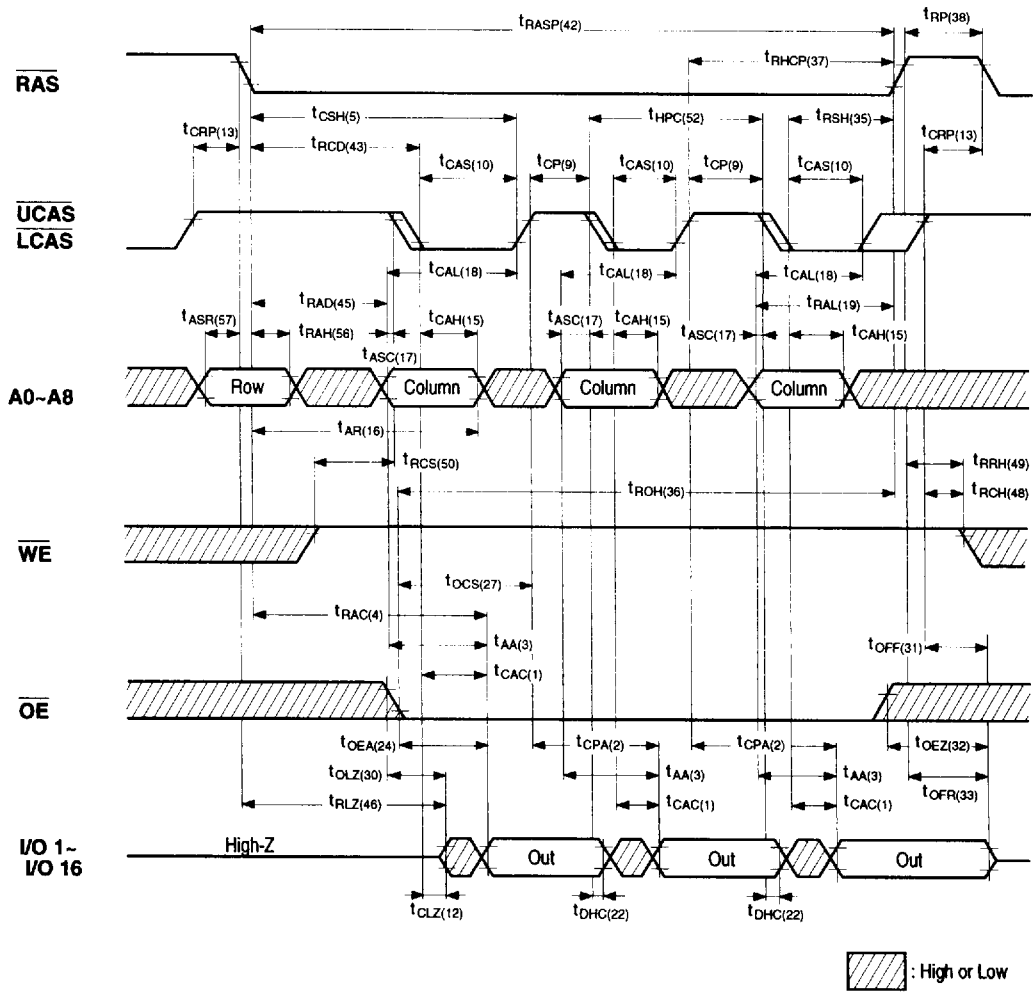
WORD READ-MODIFY-WRITE CYCLE



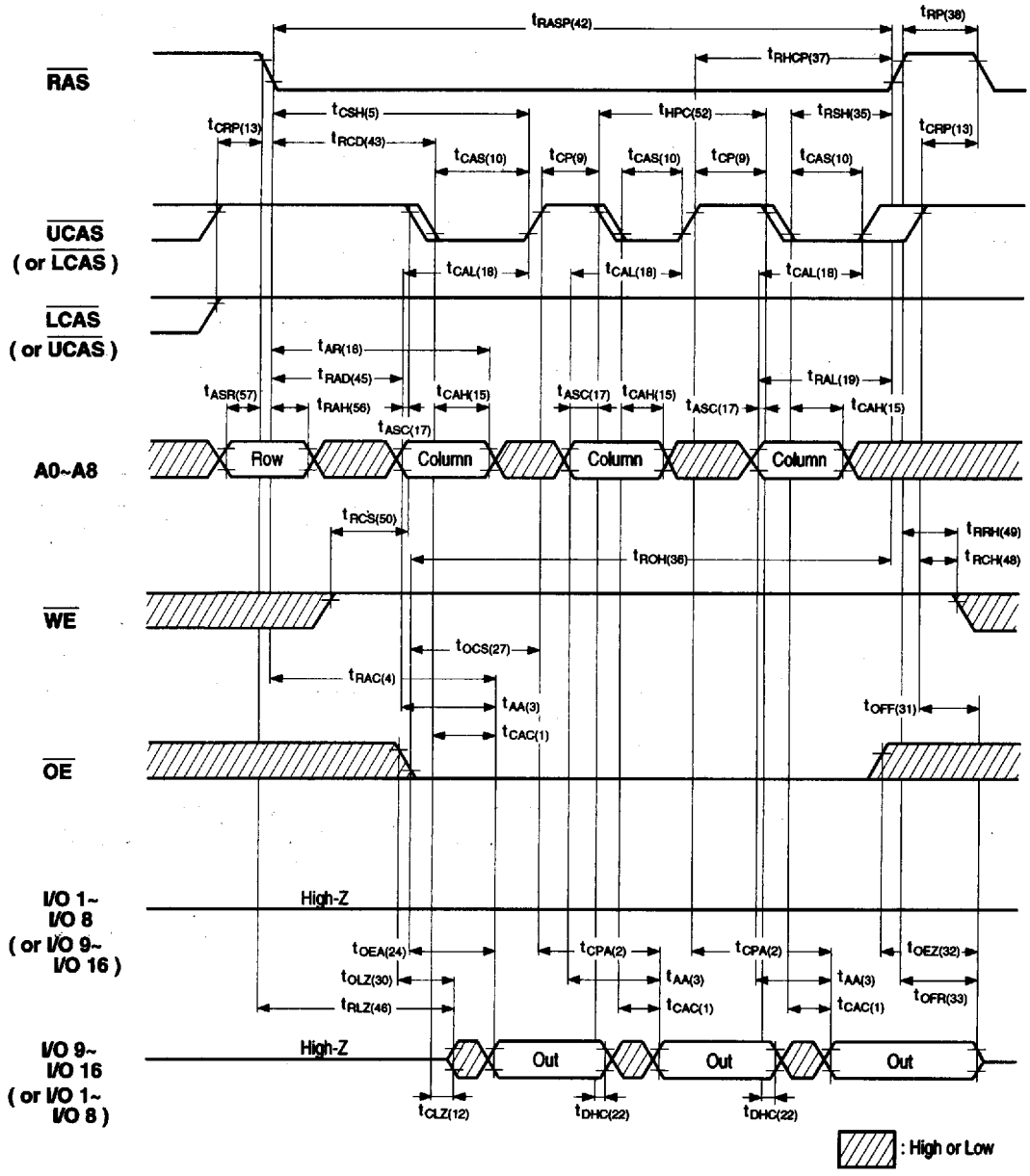
BYTE READ-MODIFY-WRITE CYCLE



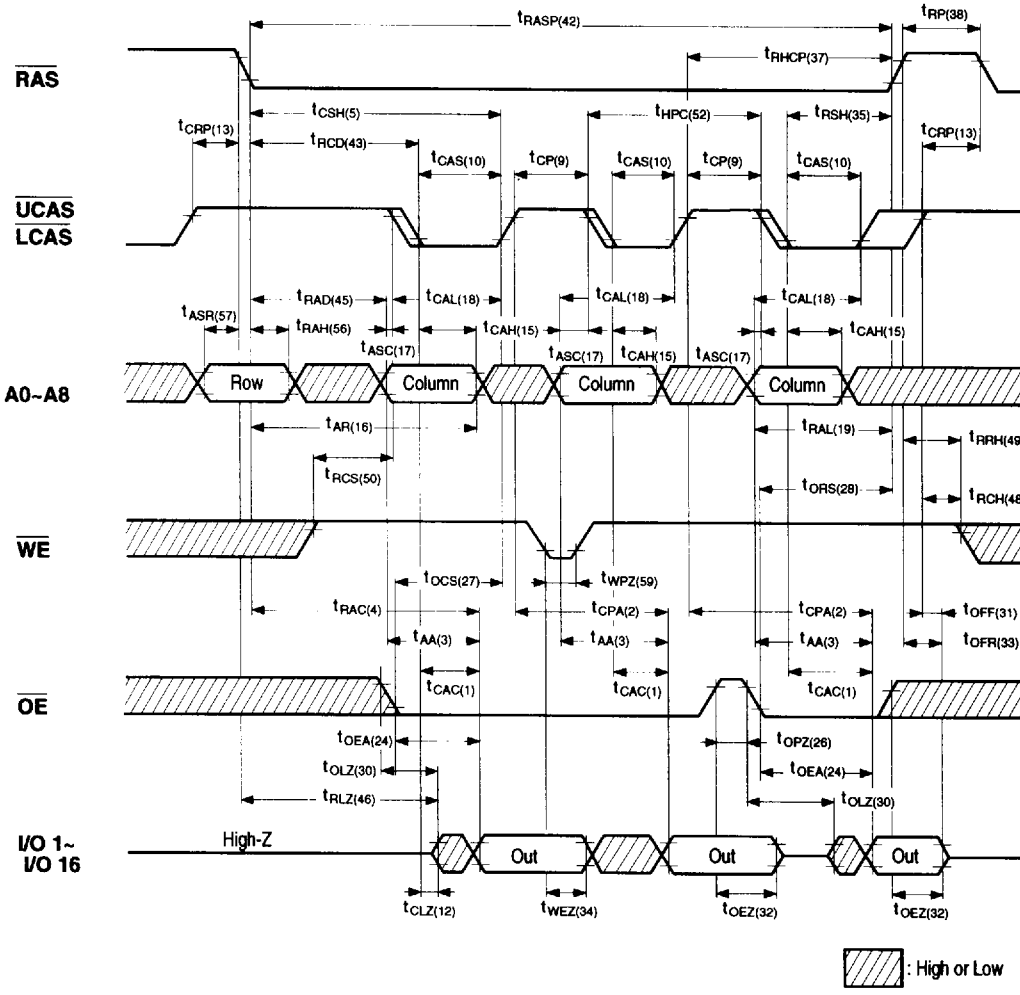
EDO (HYPER PAGE) MODE WORD READ CYCLE



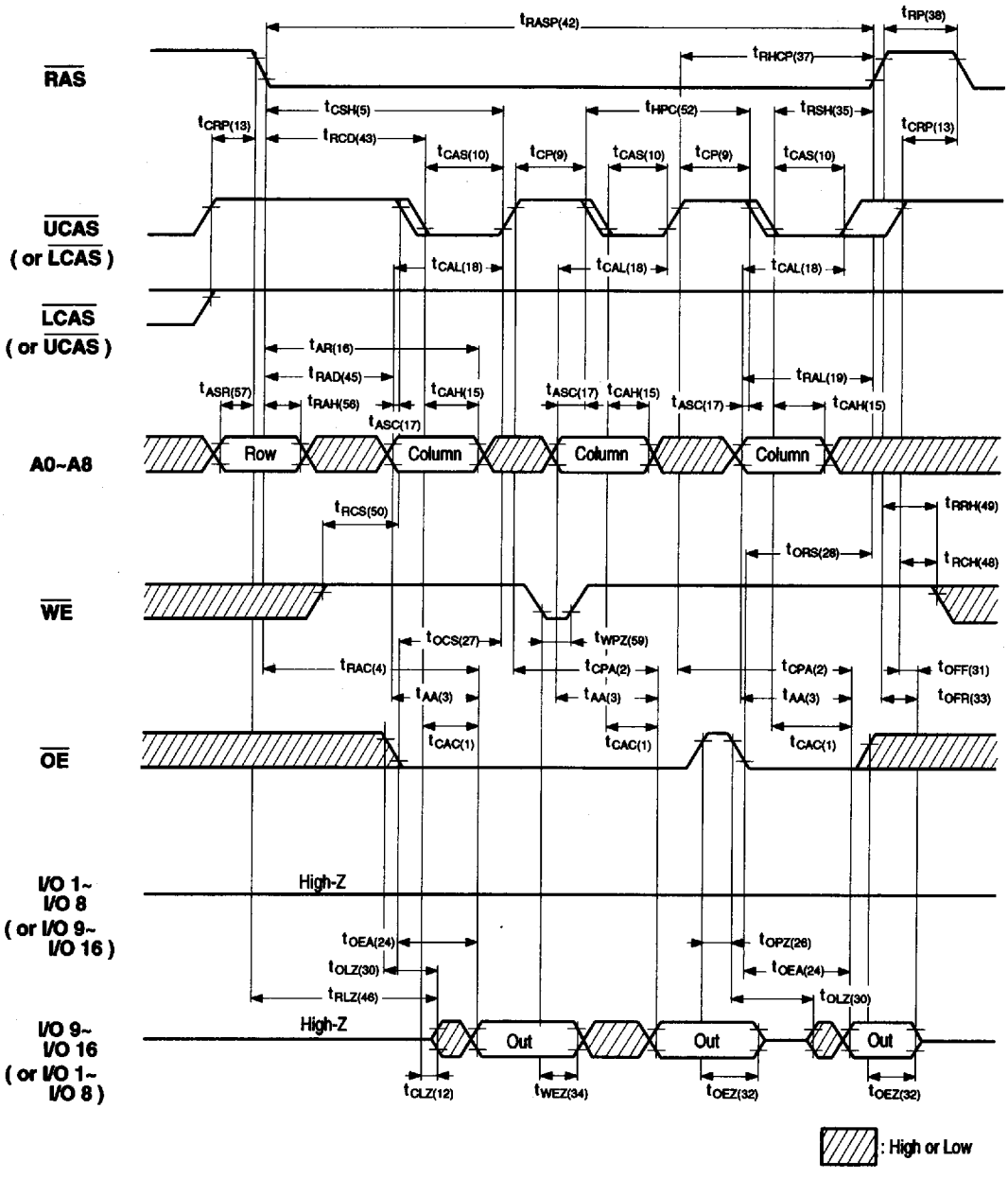
EDO (HYPER PAGE) MODE BYTE READ CYCLE



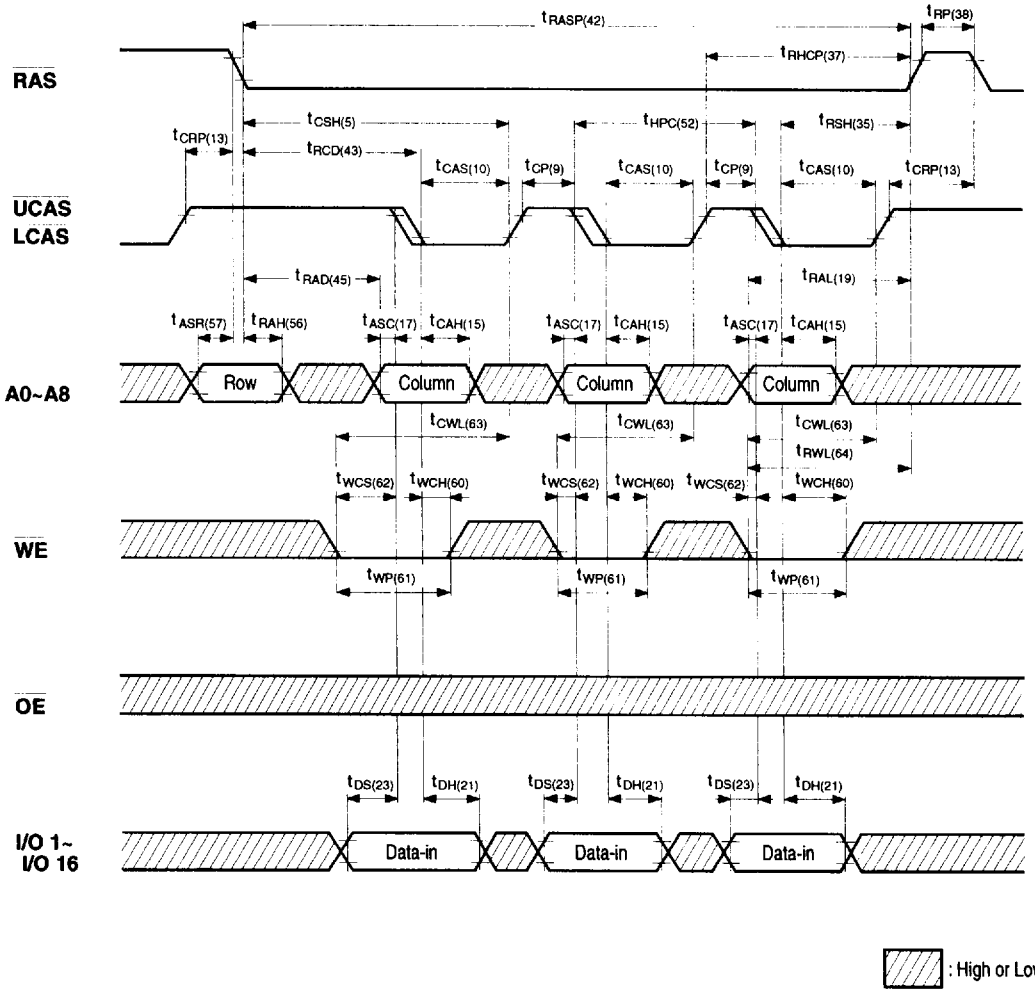
EDO (HYPER PAGE) MODE WORD READ CYCLE ($\overline{OE}$ AND $\overline{WE}$ CONTROLLED OUTPUT)



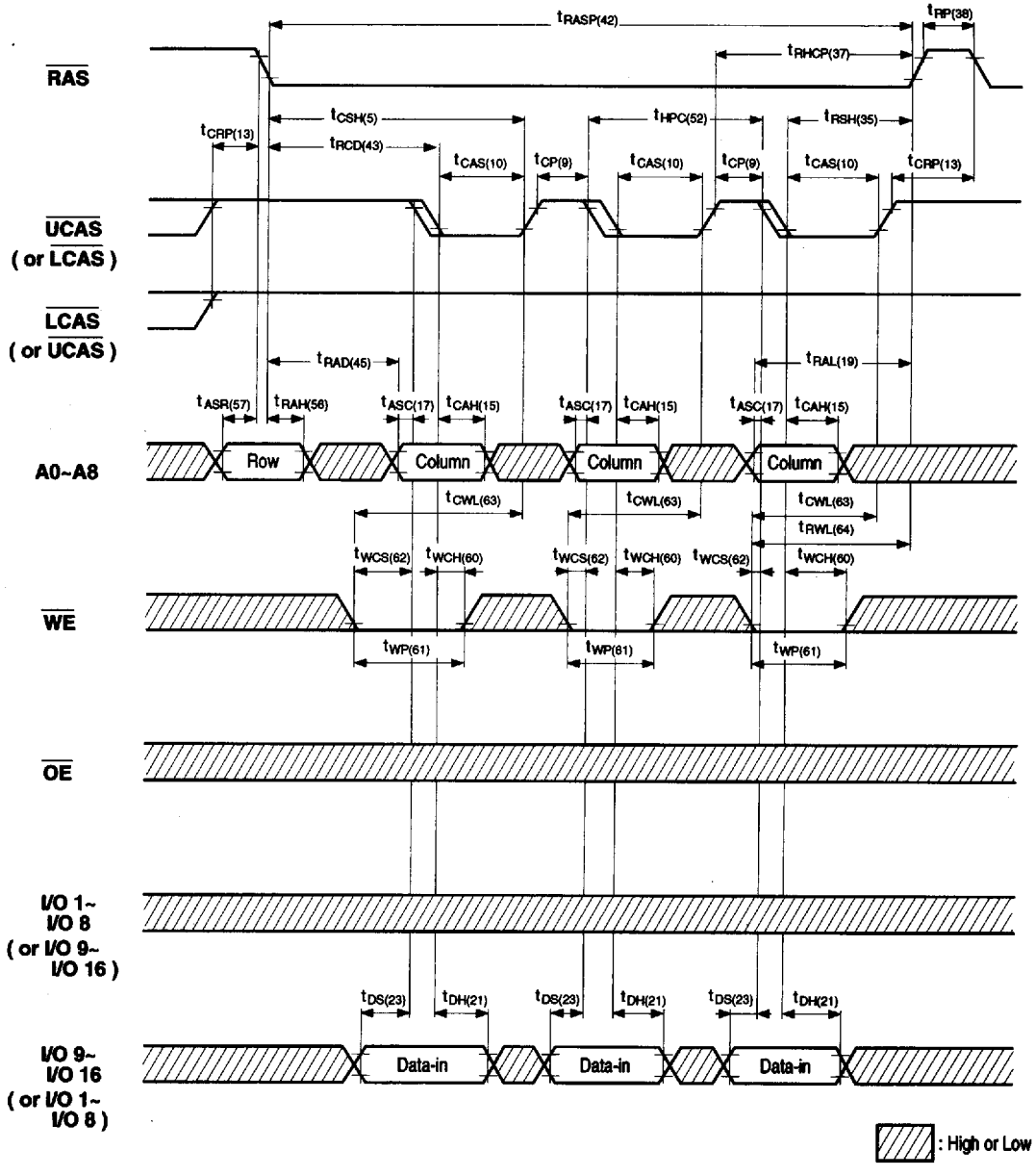
EDO (HYPER PAGE) MODE BYTE READ CYCLE ($\overline{OE}$ AND $\overline{WE}$ CONTROLLED OUTPUT)



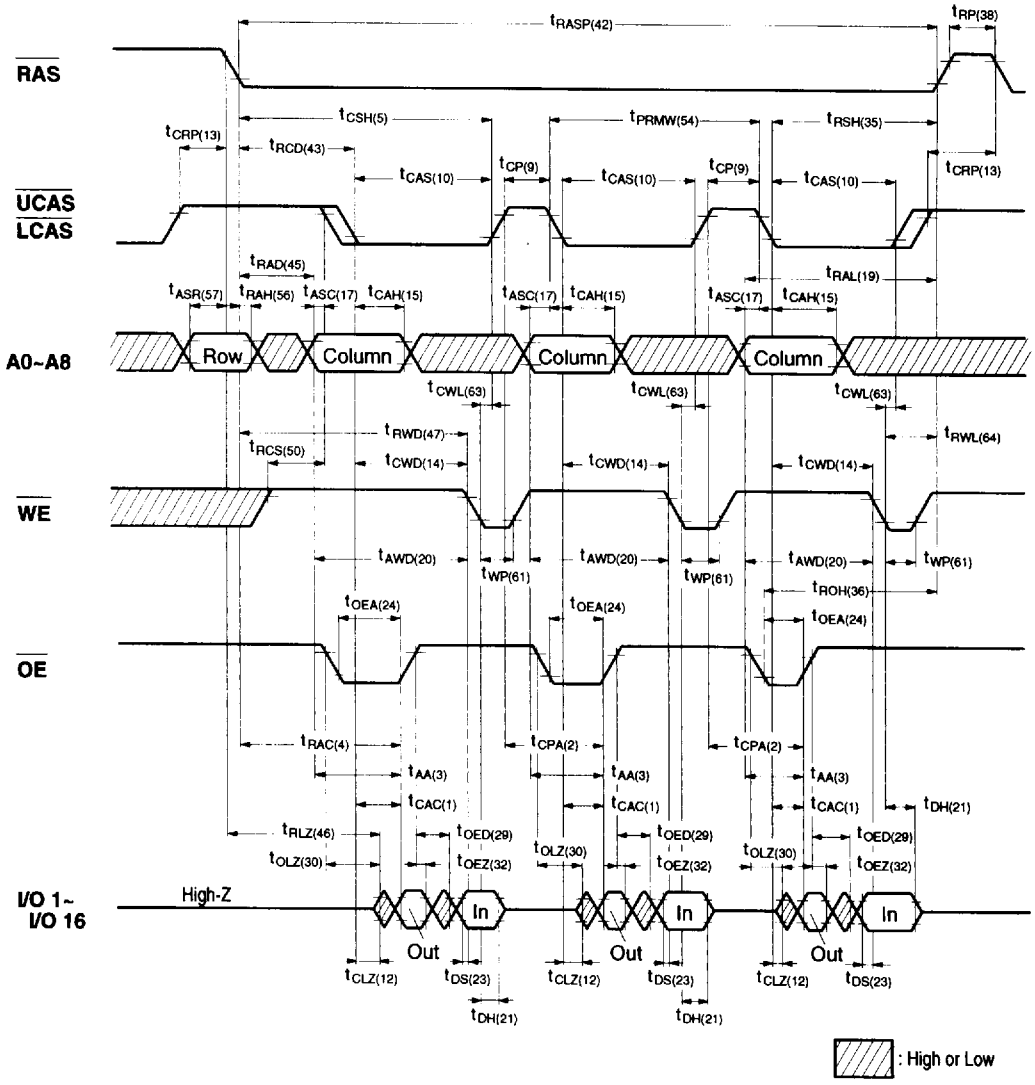
EDO (HYPER PAGE) MODE EARLY WORD WRITE CYCLE



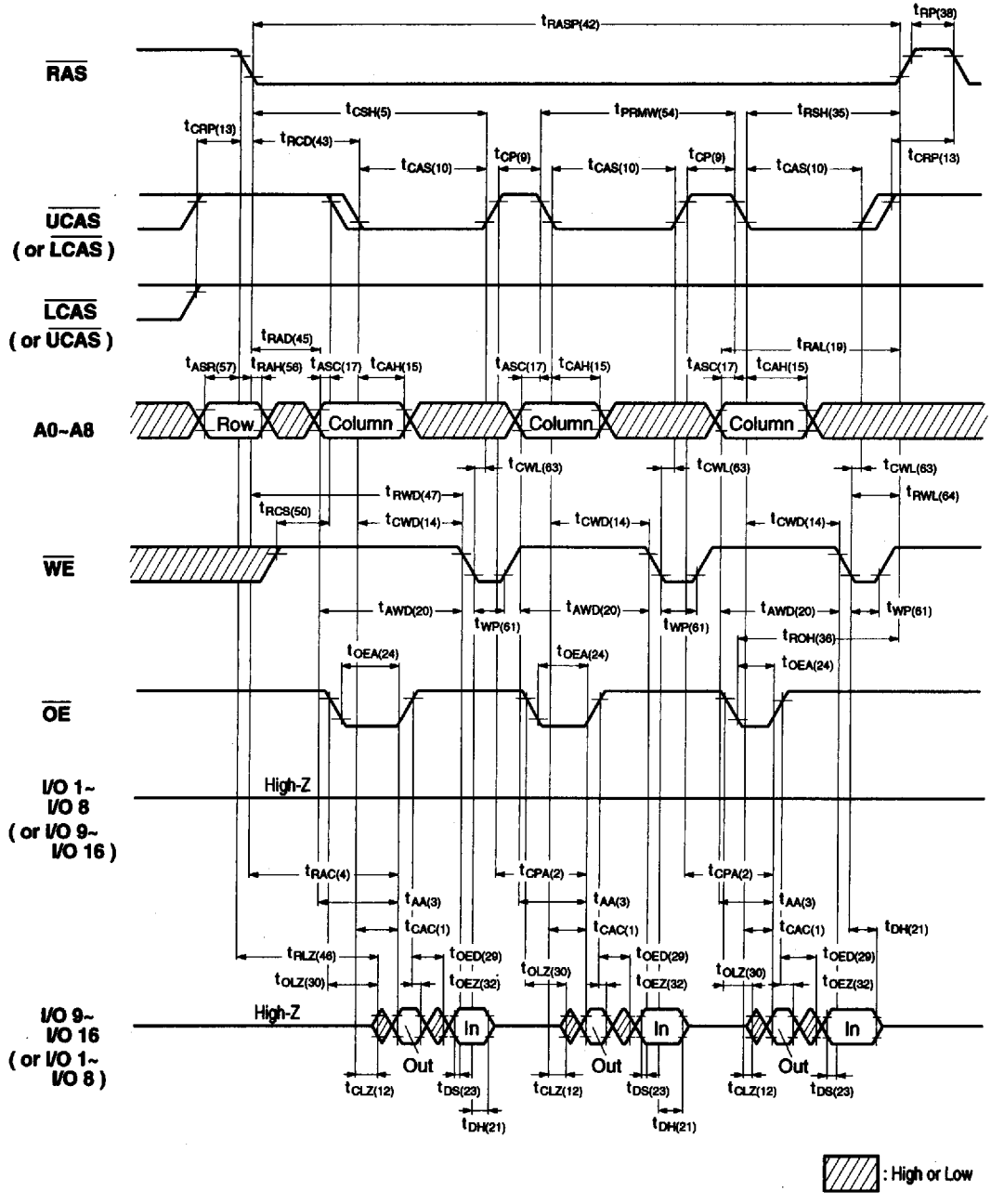
EDO (HYPER PAGE) MODE EARLY BYTE WRITE CYCLE



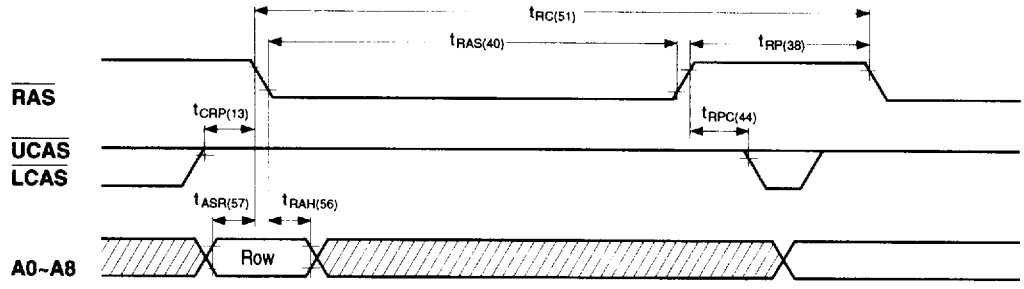
EDO (HYPER PAGE) MODE WORD READ-MODIFY-WRITE CYCLE



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

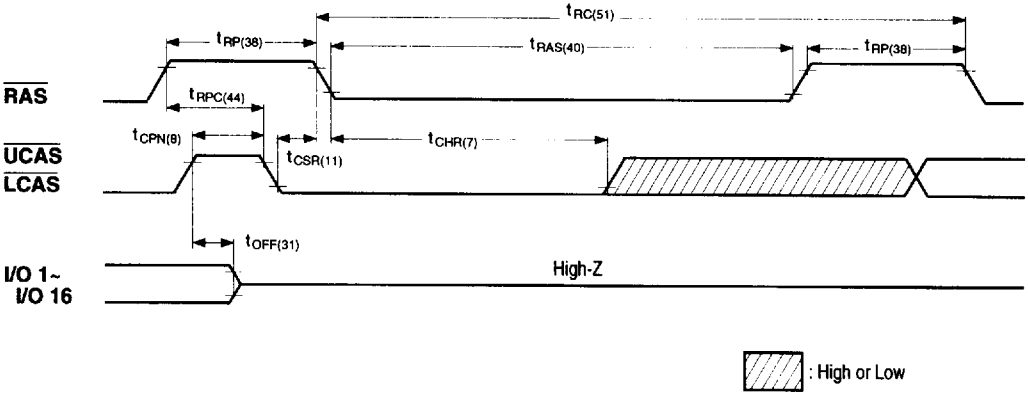


$\overline{RAS}$ ONLY REFRESH CYCLE



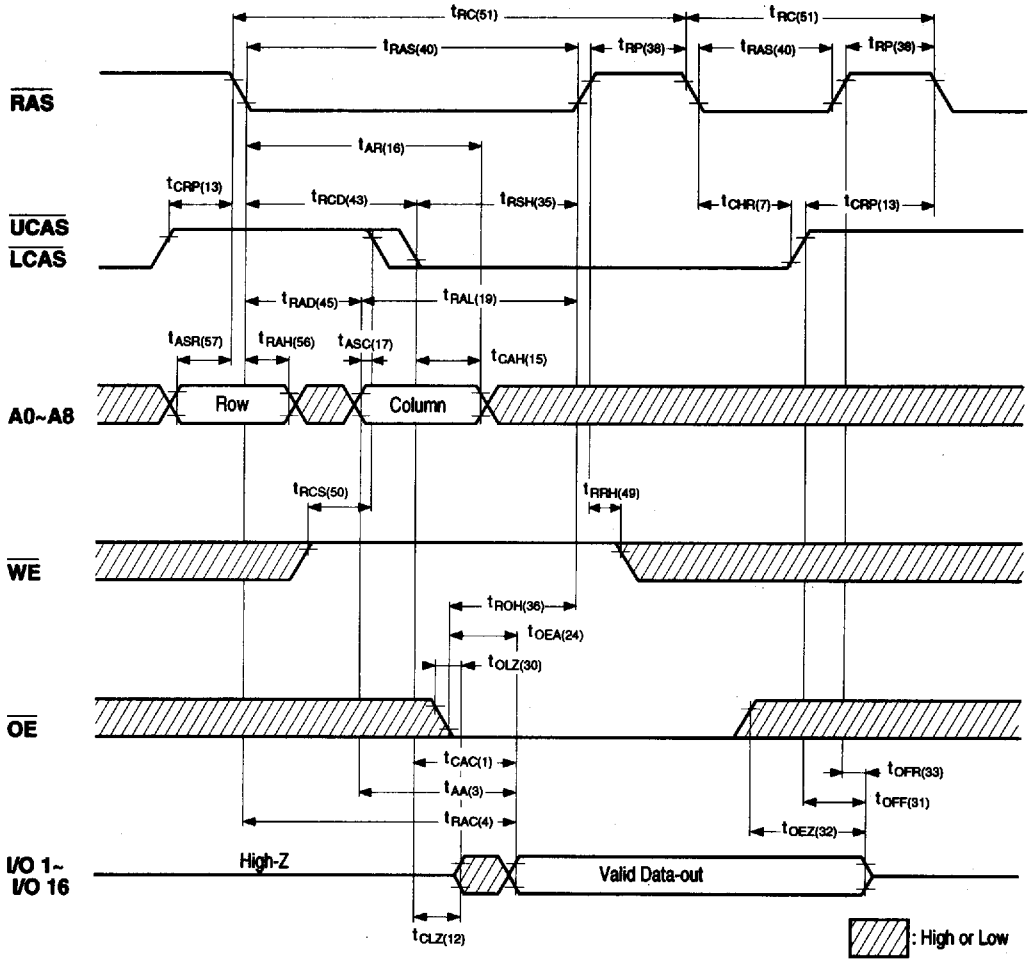
Note: $\overline{WE}$, $\overline{OE}$ = Don't care.

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

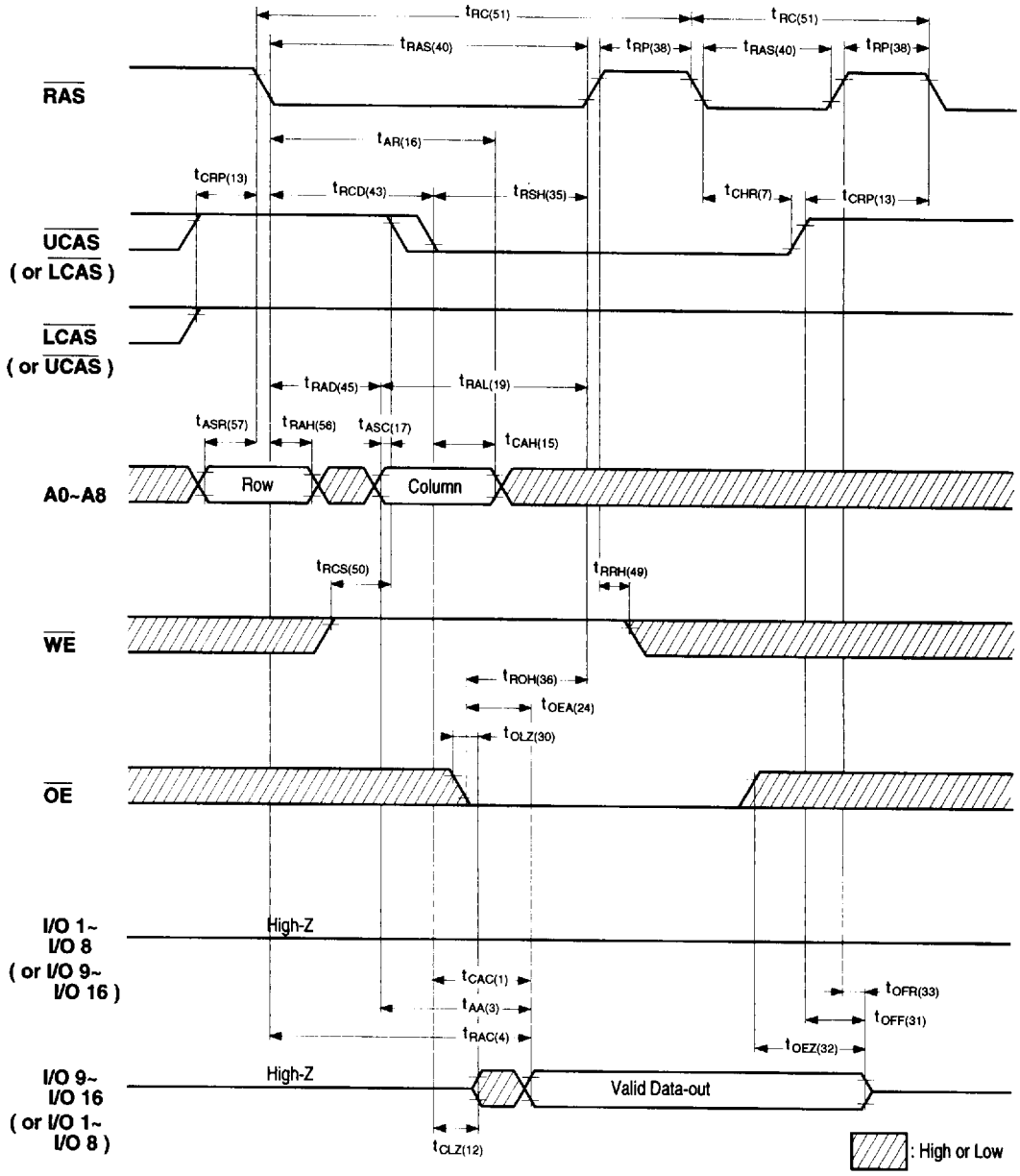


Note: $\overline{OE}$, A0~A8 = Don't care.

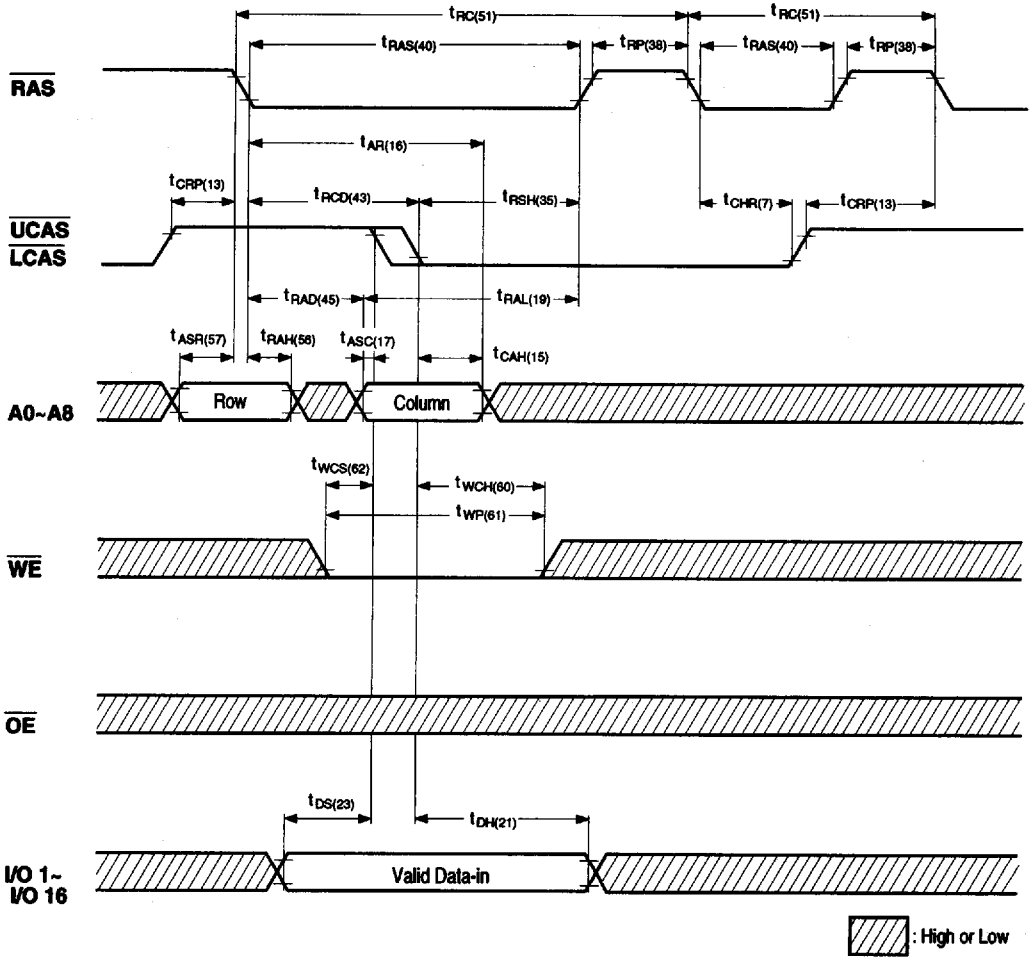
HIDDEN REFRESH CYCLE (WORD READ)



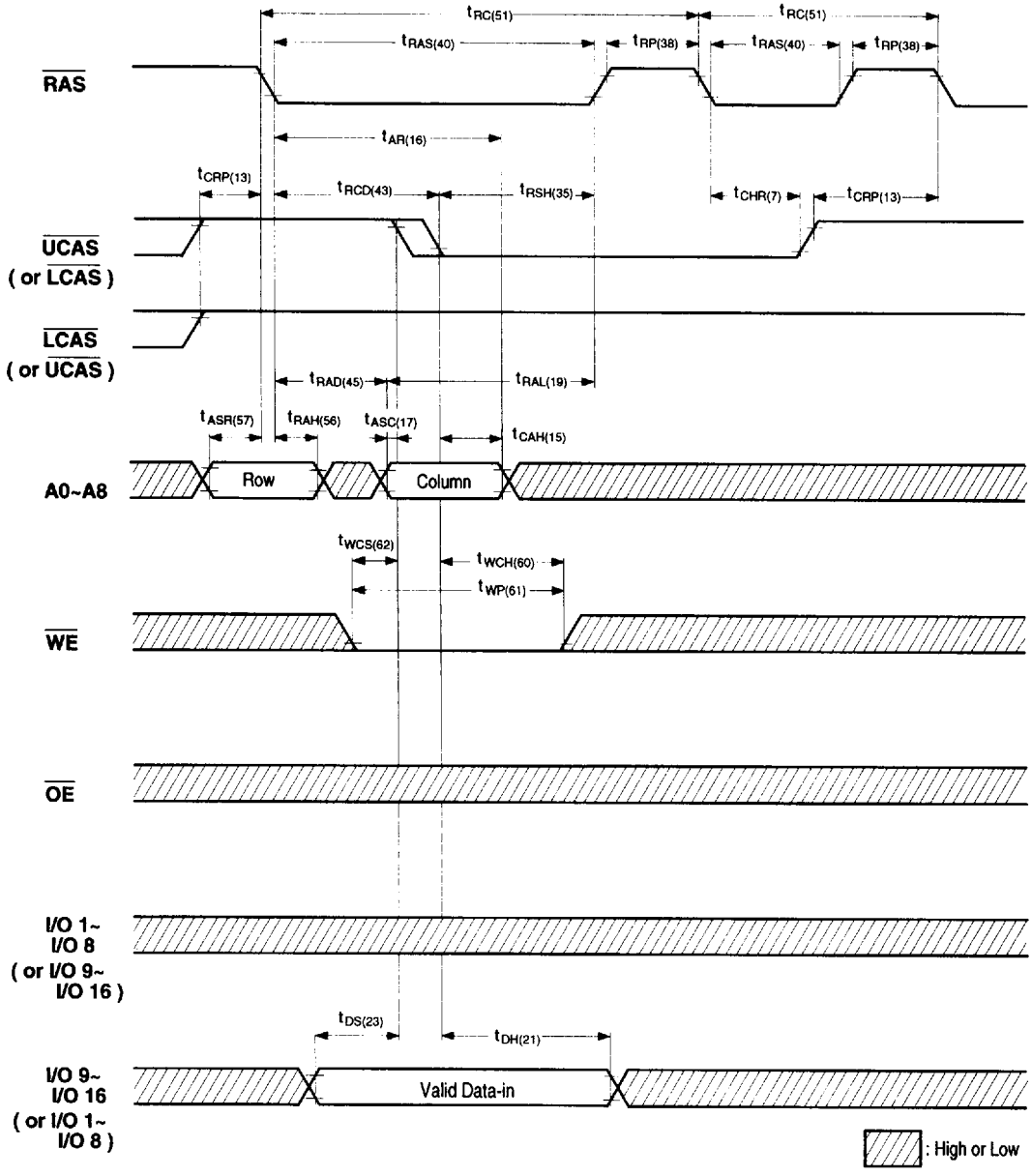
HIDDEN REFRESH CYCLE (BYTE READ)



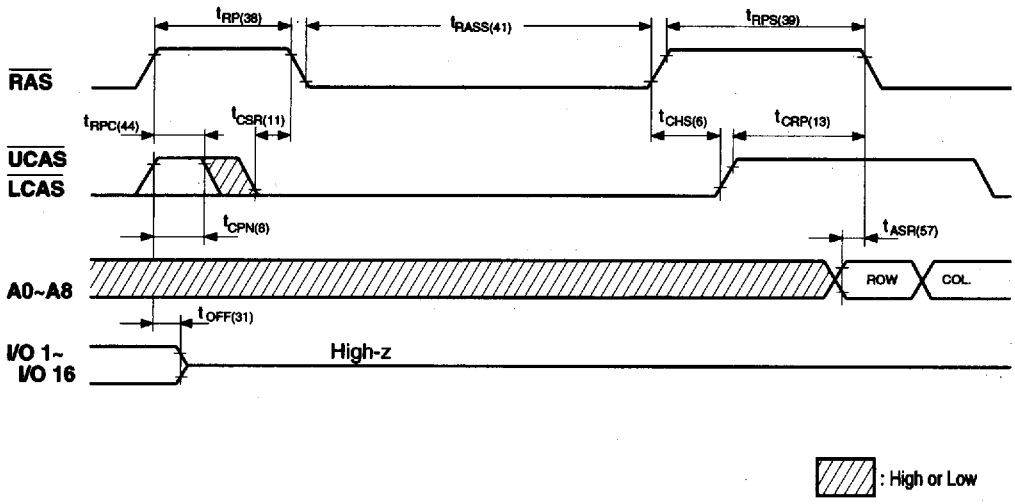
HIDDEN REFRESH CYCLE (EARLY WORD WRITE)



HIDDEN REFRESH CYCLE (EARLY BYTE WRITE)



SELF REFRESH MODE



■ The NN514265L/AL version has a Self Refresh Mode.

a. Entering the Self Refresh Mode:
The NN514265L/LA Self Refresh Mode is entered by using $\overline{CAS}$ before $\overline{RAS}$ cycle and holding $\overline{RAS}$ and $\overline{CAS}$ 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 to continue the Self Refresh Mode.

c. Exiting the Self Refresh Mode:
The NN514265L/LA exits the Self Refresh Mode when the $\overline{RAS}$ signal is brought " high ".

ORDERING INFORMATION

NN514265XX(X) - XX

SPEED	45	:	45ns
	50	:	50ns
	60	:	60ns
	70	:	70ns
PACKAGE	J	:	Plastic SOJ
	TT	:	Plastic TSOP TYPEII
VERSION	BLANK	:	Standard Version
	L	:	Long Refresh Version 128ms Refresh
MODE	4265	:	EDO (Hyper Page) 2CAS ,256K x 16 ,512refresh cycle

NN514265AXX(X) - XX

SPEED	35	:	35ns
	40	:	40ns
	45	:	45ns
	50	:	50ns
	60	:	60ns
PACKAGE	J	:	Plastic SOJ
	TT	:	Plastic TSOP TYPEII
VERSION	BLANK	:	Standard Version
	L	:	Long Refresh Version 128ms Refresh
DESIGN CODE	A	:	NN514260A
MODE	4265	:	EDO (Hyper Page) 2CAS ,256K x 16 ,512refresh cycle