M5M4V18160BTP-6,-7,-6S,-7S

FAST PAGE MODE 16777216-BIT (1048576-WORD BY 16-BIT) DYNAMIC RAM

DESCRIPTION

This is a family of 1048576-word by 16-bit dynamic RAMS, fabricated with the high performance CMOS process,and is ideal for large-capacity memory systems where high speed, low power dissipation , and low costs are essential.

The use of double-layer aluminum process combined with triple-well CMOS technology and a single-transistor dynamic storage stacked capacitor cell provide high circuit density at reduced costs. Multiplexed address inputs permit both a reduction in pins and an increase in system densities.

FEATURES

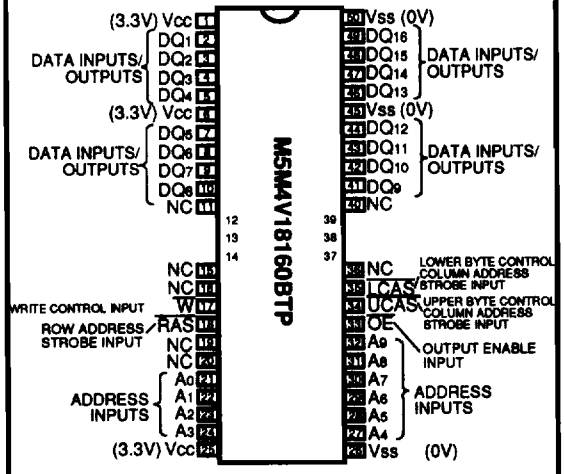
Type name	$\overline{RAS}$ access time (max.ns)	$\overline{CAS}$ access time (max.ns)	Address access time (max.ns)	$\overline{OE}$ access time (max.ns)	Cycle time (min.ns)	Power dissipation (typ.mW)
M5M4V18160BTP-6,-6S	60	15	30	15	110	450
M5M4V18160BTP-7,-7S	70	20	35	20	130	390

- Standard 50pin TSOP
- Single 3.3V ± 0.3V supply
- Low stand-by power dissipation
  1.8mW (Max) ..... CMOS input level
- Low operating power dissipation
  M5M4V18160BTP -6, -6S ..... 620.0mW (Max)
  M5M4V18160BTP-7, -7S ..... 540.0mW (Max)
- Fast-page mode, Read-modify-write,$\overline{RAS}$-only refresh, $\overline{CAS}$ before $\overline{RAS}$ refresh, Hidden refresh capabilities
- Early-write mode and $\overline{OE}$ to control output buffer impedance
- All inputs, output TTL compatible and low capacitance
- 1024 refresh cycles every 16.4ms (A_0 ~A_9)

APPLICATION

Main memory unit for computers, Microcomputer memory, Refresh memory for CRT

PIN CONFIGURATION (TOP VIEW)



Outline 50P3W-L (400mil TSOP)

NC : NO CONNECTION

FUNCTION

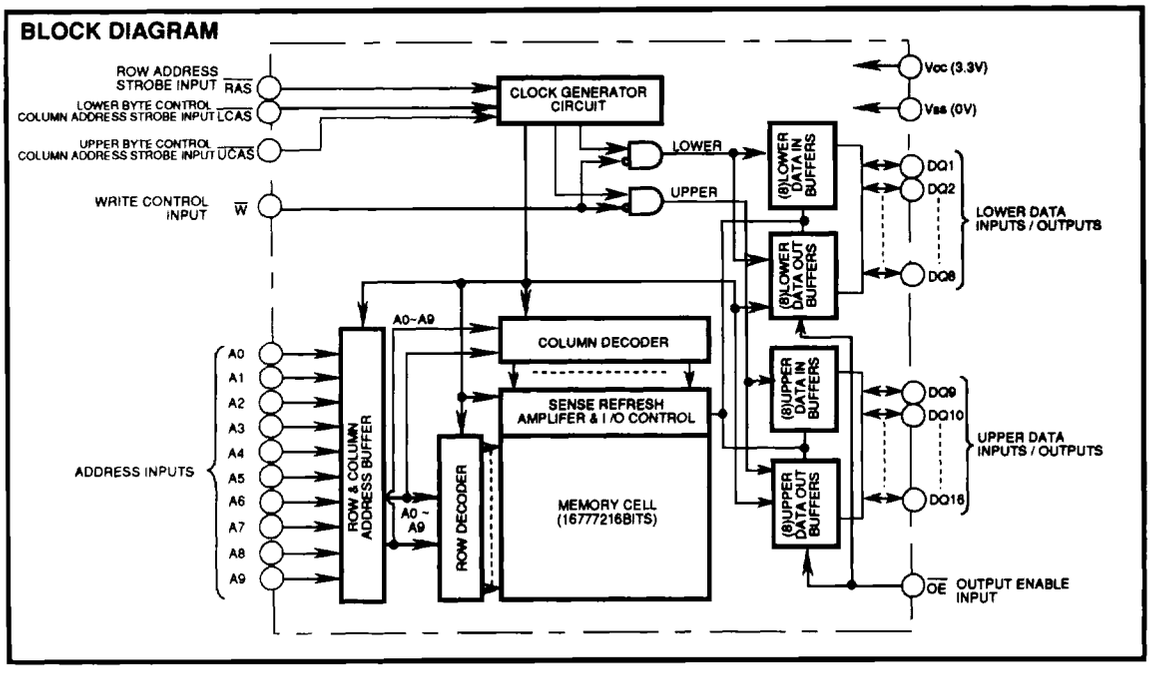
The M5M4V18160BTP provide, in addition to normal read, write, and read-modify-write operations, a number of otherv functions, e.g., fast page mode, $\overline{RAS}$-only refresh, and delayed-write. The input conditions for each are shown in Table 1.

Table 1 Input conditions for each mode

Operation	Inputs					Input/Output	
	$\overline{RAS}$	$\overline{LCAS}$	$\overline{UCAS}$	$\overline{W}$	$\overline{OE}$	DQ1-DQ8	DQ9-DQ16
Lower byte Read	ACT	ACT	NAC	NAC	ACT	DOUT	OPN
Upper byte Read	ACT	NAC	ACT	NAC	ACT	OPN	DOUT
Word Read	ACT	ACT	ACT	NAC	ACT	DOUT	DOUT
Lower Byte Write	ACT	ACT	NAC	ACT	NAC	DIN	DNC
Upper Byte Write	ACT	NAC	ACT	ACT	NAC	DNC	DIN
Word write	ACT	ACT	ACT	ACT	NAC	DIN	DIN
$\overline{RAS}$-only refresh	ACT	NAC	NAC	DNC	DNC	OPN	OPN
Lower Byte Hidden refresh	ACT	ACT	NAC	NAC	ACT	DOUT	OPN
Upper Byte Hidden refresh	ACT	NAC	ACT	NAC	ACT	OPN	DOUT
Hidden refresh	ACT	ACT	ACT	NAC	ACT	DOUT	DOUT
$\overline{CAS}$ before $\overline{RAS}$ refresh	ACT	ACT	ACT	DNC	DNC	OPN	OPN
Stand-by	NAC	DNC	DNC	DNC	DNC	OPN	OPN

Note : ACT : active, NAC : nonactive, DNC : don' t care, VLD : valid, IVD : invalid, APD : applied, OPN : open

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
Vcc	Supply voltage	With respect to Vss	-0.5~4.6	V
V_I	Input voltage		-0.5~4.6	V
Vo	Output voltage		-0.5~4.6	V
Io	Output current		50	mA
Pd	Power dissipation	Ta=25°C	1000	mW
Topr	Operating temperature		0~70	°C
Tstg	Storage temperature		-65~150	°C

RECOMMENDED OPERATING CONDITIONS (Ta=0~70°C, unless otherwise noted) (Note 1)

Symbol	Parameter	Limits			Unit
		Min	Nom	Max	
Vcc	Supply voltage	3.0	3.3	3.6	V
Vss	Supply voltage	0	0	0	V
V_{IH}	High-level input voltage, all inputs	2.0		Vcc+0.3	V
V_{IL}	Low-level input voltage, all inputs	-0.3		0.8	V

Note 1 : All voltage values are with respect to Vss.

ELECTRICAL CHARACTERISTICS (Ta=0~70°C, Vcc=3.3V±0.3V, Vss=0V, unless otherwise noted) (Note 2)

Symbol	Parameter		Test conditions	Limits			Unit
				Min	Typ	Max	
V_{OH}	High-level output voltage		I_{OH}=-2.0mA	2.4		Vcc	V
V_{OL}	Low-level output voltage		I_{OL}=2.0mA	0		0.4	V
Ioz	Off-state output current		Q floating, 0V≦V_{OUT}≦3.3V	-10		10	μA
I_I	Input current		0V≦V_{IN}≦Vcc+0.3V,Other inputs pins=0V	-10		10	μA
I_{CC1} (AV)	Average supply current from Vcc operating (Note 3,4,5)	M5M4V18160B-6,-6S	$\overline{RAS}$, $\overline{CAS}$ cycling t_{RC}=t_{WC}=min. output open			170	mA
		M5M4V18160B-7,-7S				150	
I_{CC2}	Supply current from Vcc, stand-by (Note 6)		$\overline{RAS}$=$\overline{CAS}$=V_{IH}, output open			2	mA
		M5M4V18160B-6,-7	$\overline{RAS}$=$\overline{CAS}$≧Vcc -0.2V, output open			0.5	
		M5M4V18160B-6S,-7S	$\overline{RAS}$=$\overline{CAS}$≧Vcc -0.2V, output open			0.15	
I_{CC3} (AV)	Average supply current from Vcc refreshing (Note 3,5)	M5M4V18160B-6,-6S	$\overline{RAS}$ cycling, $\overline{CAS}$=V_{IH} t_{RC}=min. output open			170	mA
		M5M4V18160B-7,-7S				150	
I_{CC4}(AV)	Average supply current from Vcc Fast-Page-Mode (Note 3,4,5)	M5M4V18160B-6,-6S	$\overline{RAS}$=V_{IL}, $\overline{CAS}$ cycling t_{PC}=min. output open			85	mA
		M5M4V18160B-7,-7S				75	
I_{CC6}(AV)	Average supply current from Vcc $\overline{CAS}$ before $\overline{RAS}$ refresh mode (Note 3)	M5M4V18160B-6,-6S	$\overline{CAS}$ before $\overline{RAS}$ refresh cycling t_{RC}=min. output open			170	mA
		M5M4V18160B-7,-7S				150	

Note 2: Current flowing into an IC is positive, out is negative.
3: I_{CC1} (AV), I_{CC3} (AV) and I_{CC4} (AV) are dependent on cycle rate. Maximum current is measured at the fastest cycle rate.
4: I_{CC1} (AV) and I_{CC4} (AV) are dependent on output loading. Specified values are obtained with the output open.
5: Column Address can be changed once or less while $\overline{RAS}$=V_{IL} and $\overline{LCAS}$/$\overline{UCAS}$=V_{IH}.

CAPACITANCE (Ta=0~70°C, Vcc=3.3V±0.3V, Vss=0V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$C_{I(A)}$	Input capacitance, address inputs	V_I=Vss f=1MHz V_I=25mVrms			5	pF
$C_{I(\overline{OE})}$	Input capacitance, $\overline{OE}$ input				7	pF
$C_{I(\overline{W})}$	Input capacitance, $\overline{W}$ input				7	pF
$C_{I(\overline{RAS})}$	Input capacitance, $\overline{RAS}$ input				7	pF
$C_{I(\overline{CAS})}$	Input capacitance, $\overline{CAS}$ input				7	pF
$C_{I/O}$	Input/Output capacitance, data ports				8	pF

SWITCHING CHARACTERISTICS (Ta=0 ~ 70℃, Vcc=3.3V ± 0.3V, Vss=0V, unless otherwise noted, see notes 6,13,14)

Symbol	Parameter		Limits				Unit
			M5M4V18160B-6,-6S		M5M4V18160B-7,-7S		
			Min	Max	Min	Max	
tCAC	Access time from $\overline{CAS}$	(Note7,8)		15		20	ns
tRAC	Access time from $\overline{RAS}$	(Note7,9)		60		70	ns
tAA	Column address access time	(Note 7,10)		30		35	ns
tCPA	Access time from $\overline{CAS}$ precharge	(Note 7,11)		35		40	ns
tOEA	Access time from $\overline{OE}$	(Note 7)		15		20	ns
tCLZ	Output low impedance time from $\overline{CAS}$ low	(Note 7)	5		5		ns
tOFF	Output disable time after $\overline{CAS}$ high	(Note 12)	0	15	0	15	ns
tOEZ	Output disable time after $\overline{OE}$ high	(Note 12)	0	15	0	15	ns

Note 6: An initial pause of 500 μs is required after power-up followed by a minimum of eight initialization cycles (any combination of cycles containing a $\overline{RAS}$ clock such as $\overline{RAS}$-Only refresh).
Note the $\overline{RAS}$ may be cycled during the initial pause. And any 8 $\overline{RAS}$ or $\overline{RAS}$/$\overline{CAS}$ cycles are required after prolonged periods (greater than 16.4 ms) of $\overline{RAS}$ inactivity before proper device operation is achieved.
7: Measured with a load circuit equivalent to 100pF, V_{OH}=2.4V(I_{OH}=-2mA) and V_{OL}=0.4V(I_{OL}=2mA). The reference levels for measuring of output signals are 2.0V(V_{OH}) and 0.8V(V_{OL})
8: Assumes that $t_{RCD} \geq t_{RCD(max)}$ and $t_{ASC} \geq t_{ASC(max)}$.
9: 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} will increase by amount that t_{RCD} exceeds the value shown.
10: Assumes that $t_{RAD} \geq t_{RAD(max)}$ and $t_{ASC} \leq t_{ASC(max)}$.
11: Assumes that $t_{CP} \leq t_{CP(max)}$ and $t_{ASC} \geq t_{ASC(max)}$.
12: $t_{OFF(max)}$ and $t_{OEZ(max)}$ defines the time at which the output achieves the high impedance state ($I_{OUT} \leq |\pm 10\ \mu A|$) and is not reference to $V_{OH(min)}$ or $V_{OL(max)}$.

TIMING REQUIREMENTS (For Read, Write, Read-Modify-Write ,Refresh, and Fast-Page Mode Cycles)

(Ta=0 ~ 70 °C, Vcc=3.3V ± 0.3V, Vss=0V, unless otherwise noted, see notes 13,14)

Symbol	Parameter		Limits				Unit
			M5M4V18160B-6,-6S		M5M4V18160B-7,-7S		
			Min	Max	Min	Max	
tREF	Refresh cycle time	-6, -7		16.4		16.4	ms
tREF	Refresh cycle time	-6S, -7S		128		128	ms
tRP	$\overline{RAS}$ high pulse width		40		50		ns
tRCD	Delay time, $\overline{RAS}$ low to $\overline{CAS}$ low	(Note15)	20	45	20	50	ns
tCRP	Delay time, $\overline{CAS}$ high to $\overline{RAS}$ low		10		10		ns
tRPC	Delay time, $\overline{RAS}$ high to $\overline{CAS}$ low		0		0		ns
tCPN	$\overline{CAS}$ high pulse width		10		10		ns
tRAD	Column address delay time from $\overline{RAS}$ low	(Note16)	15	30	15	35	ns
tASR	Row address setup time before $\overline{RAS}$ low		0		0		ns
tASC	Column address setup time before $\overline{CAS}$ low	(Note17)	0	10	0	10	ns
tRAH	Row address hold time after $\overline{RAS}$ low		10		10		ns
tCAH	Column address hold time after $\overline{CAS}$ low		15		15		ns
tDZC	Delay time, data to $\overline{CAS}$ low	(Note18)	0		0		ns
tDZO	Delay time, data to $\overline{OE}$ low	(Note18)	0		0		ns
tCDD	Delay time, $\overline{CAS}$ high to data	(Note19)	15		15		ns
tODD	Delay time, $\overline{OE}$ high to data	(Note19)	15		15		ns
tT	Transition time	(Note20)	1	50	1	50	ns

Note 13: The timing requirements are assumed t_T =5ns.
14: $V_{IH(min)}$ and $V_{IL(max)}$ are reference levels for measuring timing of input signals.
15: $t_{RCD(max)}$ is specified as a reference point only. If t_{RCD} is less than $t_{RCD(max)}$, access time is t_{RAC}. If t_{RCD} is greater than $t_{RCD(max)}$, access time is controlled exclusively by t_{CAC} or t_{AA}. $t_{RCD(min)}$ is specified as $t_{RCD(min)} = t_{RAH(min)} + 2t_T + t_{ASC(min)}$.
16: $t_{RAD(max)}$ is specified as a reference point only. If $t_{RAD} \geq t_{RAD(max)}$ and $t_{ASC} \leq t_{ASC(max)}$, access time is controlled exclusively by t_{AA}.
17: $t_{ASC(max)}$ is specified as a reference point only. If $t_{RCD} \geq t_{RCD(max)}$ and $t_{ASC} \geq t_{ASC(max)}$, access time is controlled exclusively by t_{CAC}.
18: Either t_{DZC} or t_{DZO} must be satisfied.
19: Either t_{CDD} or t_{ODD} must be satisfied.
20: t_T is measured between $V_{IH(min)}$ and $V_{IL(max)}$.

Read and Refresh Cycles

Symbol	Parameter		Limits				Unit
			M5M4V18160B-6,-6S		M5M4V18160B-7,-7S		
			Min	Max	Min	Max	
tRC	Read cycle time		110		130		ns
tRAS	$\overline{RAS}$ low pulse width		60	10000	70	10000	ns
tCAS	$\overline{CAS}$ low pulse width		15	10000	20	10000	ns
tCSH	$\overline{CAS}$ hold time after $\overline{RAS}$ low		60		70		ns
tRSH	$\overline{RAS}$ hold time after $\overline{CAS}$ low		15		20		ns
tRCS	Read Setup time before $\overline{CAS}$ low		0		0		ns
tRCH	Read hold time after $\overline{CAS}$ high	(Note 21)	0		0		ns
tRRH	Read hold time after $\overline{RAS}$ high	(Note 21)	10		10		ns
tRAL	Column address to $\overline{RAS}$ hold time		30		35		ns
tOCH	$\overline{CAS}$ hold time after $\overline{OE}$ low		15		20		ns
tORH	$\overline{RAS}$ hold time after $\overline{OE}$ low		15		20		ns

Note 21: Either tRCH or tRRH must be satisfied for a read cycle.

Write Cycle (Early Write and Delayed Write)

Symbol	Parameter		Limits				Unit
			M5M4V18160B-6,-6S		M5M4V18160B-7,-7S		
			Min	Max	Min	Max	
tWC	Write cycle time		110		130		ns
tRAS	$\overline{RAS}$ low pulse width		60	10000	70	10000	ns
tCAS	$\overline{CAS}$ low pulse width		15	10000	20	10000	ns
tCSH	$\overline{CAS}$ hold time after $\overline{RAS}$ low		60		70		ns
tRSH	$\overline{RAS}$ hold time after $\overline{CAS}$ low		15		20		ns
tWCS	Write setup time before $\overline{CAS}$ low	(Note 23)	0		0		ns
tWCH	Write hold time after $\overline{CAS}$ low		10		10		ns
tCWL	$\overline{CAS}$ hold time after $\overline{W}$ low		15		20		ns
tRWL	$\overline{RAS}$ hold time after $\overline{W}$ low		15		20		ns
tWP	Write pulse width		10		10		ns
tDS	Data setup time before $\overline{CAS}$ low or $\overline{W}$ low		0		0		ns
tDH	Data hold time after $\overline{CAS}$ low or $\overline{W}$ low		10		15		ns
tOEH	$\overline{OE}$ hold time after $\overline{W}$ low		15		20		ns

Read-Write and Read-Modify-Write Cycles

Symbol	Parameter		Limits				Unit
			M5M4V18160B-6,-6S		M5M4V18160B-7,-7S		
			Min	Max	Min	Max	
t_{RWC}	Read write/read modify write cycle time	(Note22)	155		180		ns
t_{RAS}	$\overline{RAS}$ low pulse width		105	10000	120	10000	ns
t_{CAS}	$\overline{CAS}$ low pulse width		60	10000	70	10000	ns
t_{CSH}	$\overline{CAS}$ hold time after $\overline{RAS}$ low		105		120		ns
t_{RSH}	$\overline{RAS}$ hold time after $\overline{CAS}$ low		60		70		ns
t_{RCS}	Read setup time before $\overline{CAS}$ low		0		0		ns
t_{CWD}	Delay time, $\overline{CAS}$ low to $\overline{W}$ low	(Note23)	40		45		ns
t_{RWD}	Delay time, $\overline{RAS}$ low to $\overline{W}$ low	(Note23)	85		95		ns
t_{AWD}	Delay time, address to $\overline{W}$ low	(Note23)	55		60		ns
t_{CWL}	$\overline{CAS}$ hold time after $\overline{W}$ low		15		20		ns
t_{RWL}	$\overline{RAS}$ hold time after $\overline{W}$ low		15		20		ns
t_{WP}	Write pulse width		10		10		ns
t_{DS}	Data setup time before $\overline{W}$ low		0		0		ns
t_{DH}	Data hold time after $\overline{W}$ low		10		15		ns
t_{OEH}	$\overline{OE}$ hold time after $\overline{W}$ low		15		15		ns

Note 22: t_{RWC} is specified as $t_{RWC(min)}=t_{RAC(max)}+t_{ODD(min)}+t_{RWL(min)}+t_{RP(min)}+5t_T$.
23: t_{WCS}, t_{CWD}, t_{RWD} and t_{AWD} and, t_{CPWD} are specified as reference points only. If $t_{WCS} \geqq t_{WCS(min)}$ the cycle is an early write cycle and the DQpins will remain high impedance throughout the entire cycle. If $t_{CWD} \geqq t_{CWD(min)}$, $t_{RWD} \geqq t_{RWD(min)}$, $t_{AWD} \geqq t_{AWD(min)}$ and $t_{CPWD} \geqq t_{CPWD(min)}$ (for fast page mode cycle only), the cycle is a read-modify-write cycle and the DQ will contain the data read from the selected address. If neither of the above condition (delayed write) of the DQ (at access time and until $\overline{CAS}$ or $\overline{OE}$ goes back to V_{IH}) is indeterminate.

Fast-Page Mode Cycle (Read, Early Write, Read -Write, Read-Modify-Write Cycle) (Note 24)

Symbol	Parameter		Limits				Unit
			M5M4V18160B-6,-6S		M5M4V18160B-7,-7S		
			Min	Max	Min	Max	
t_{PC}	Fast page mode read/write cycle time		40		45		ns
t_{PRWC}	Fast page mode read write/read modify write cycle time		85		95		ns
t_{RAS}	$\overline{RAS}$ low pulse width for read write cycle	(Note25)	100	125000	115	125000	ns
t_{CP}	$\overline{CAS}$ high pulse width	(Note26)	10	15	10	15	ns
t_{CPRH}	$\overline{RAS}$ hold time after $\overline{CAS}$ precharge		35		40		ns
t_{CPWD}	Delay time, $\overline{CAS}$ precharge to $\overline{W}$ low	(Note23)	60		65		ns

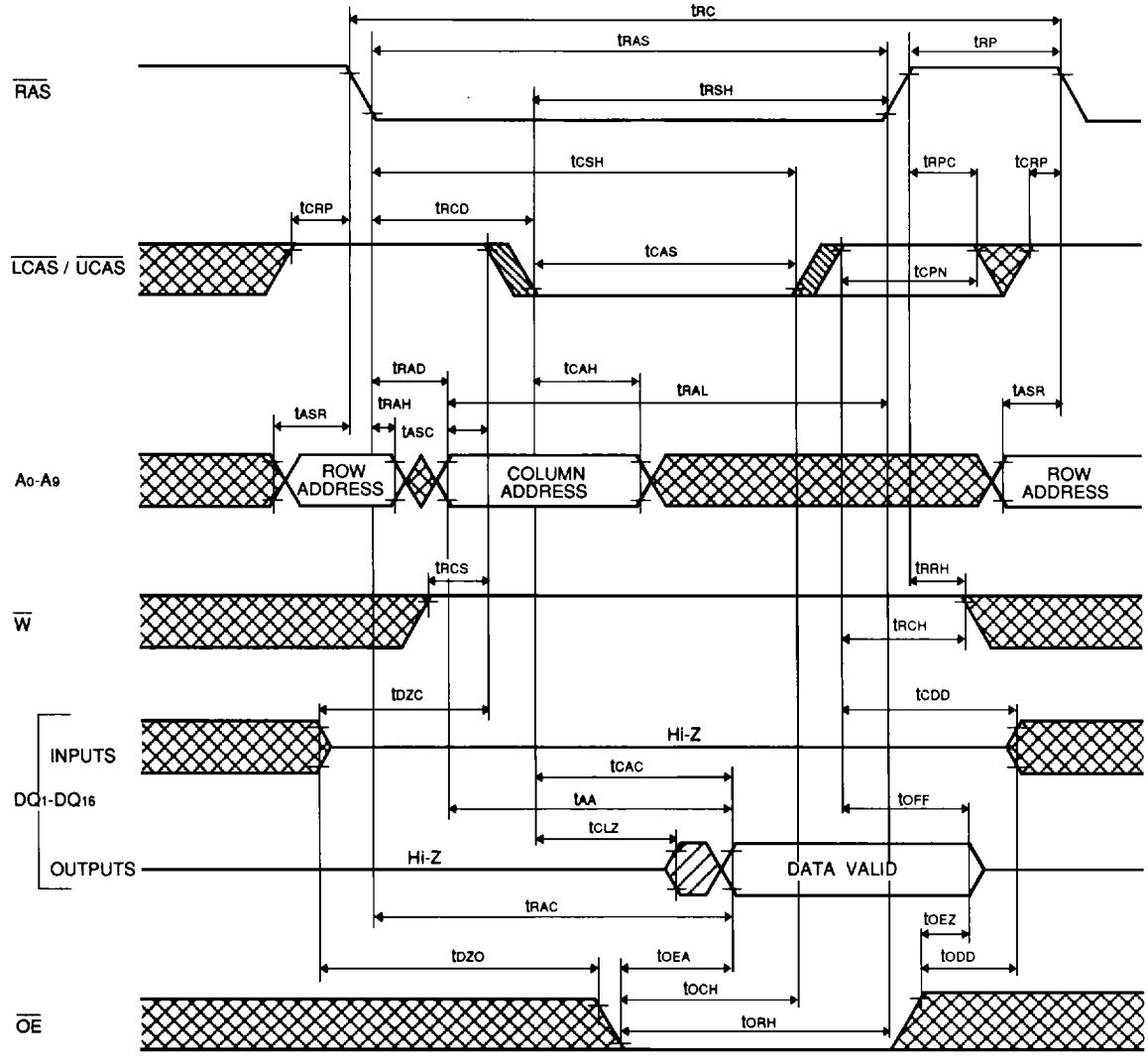
Note 24: All previously specified timing requirements and switching characteristics are applicable to their respective fast page mode cycle.
25: $t_{RAS(min)}$ is specified as two cycles of $\overline{CAS}$ input are performed.
26: $t_{CP(max)}$ is specified as a reference point only.

$\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle (Note 27)

Symbol	Parameter	Limits				Unit
		M5M4V18160B-6,-6S		M5M4V18160B-7,-7S		
		Min	Max	Min	Max	
t_{CSR}	$\overline{CAS}$ setup time before $\overline{RAS}$ low	10		10		ns
t_{CHR}	$\overline{CAS}$ hold time after $\overline{RAS}$ low	10		15		ns

Note 27: Eight or more $\overline{CAS}$ before $\overline{RAS}$ cycles instead of eight $\overline{RAS}$ cycles are necessary for proper operation of $\overline{CAS}$ before $\overline{RAS}$ refresh mode.

Timing Diagrams (Note 28)
Read Cycle



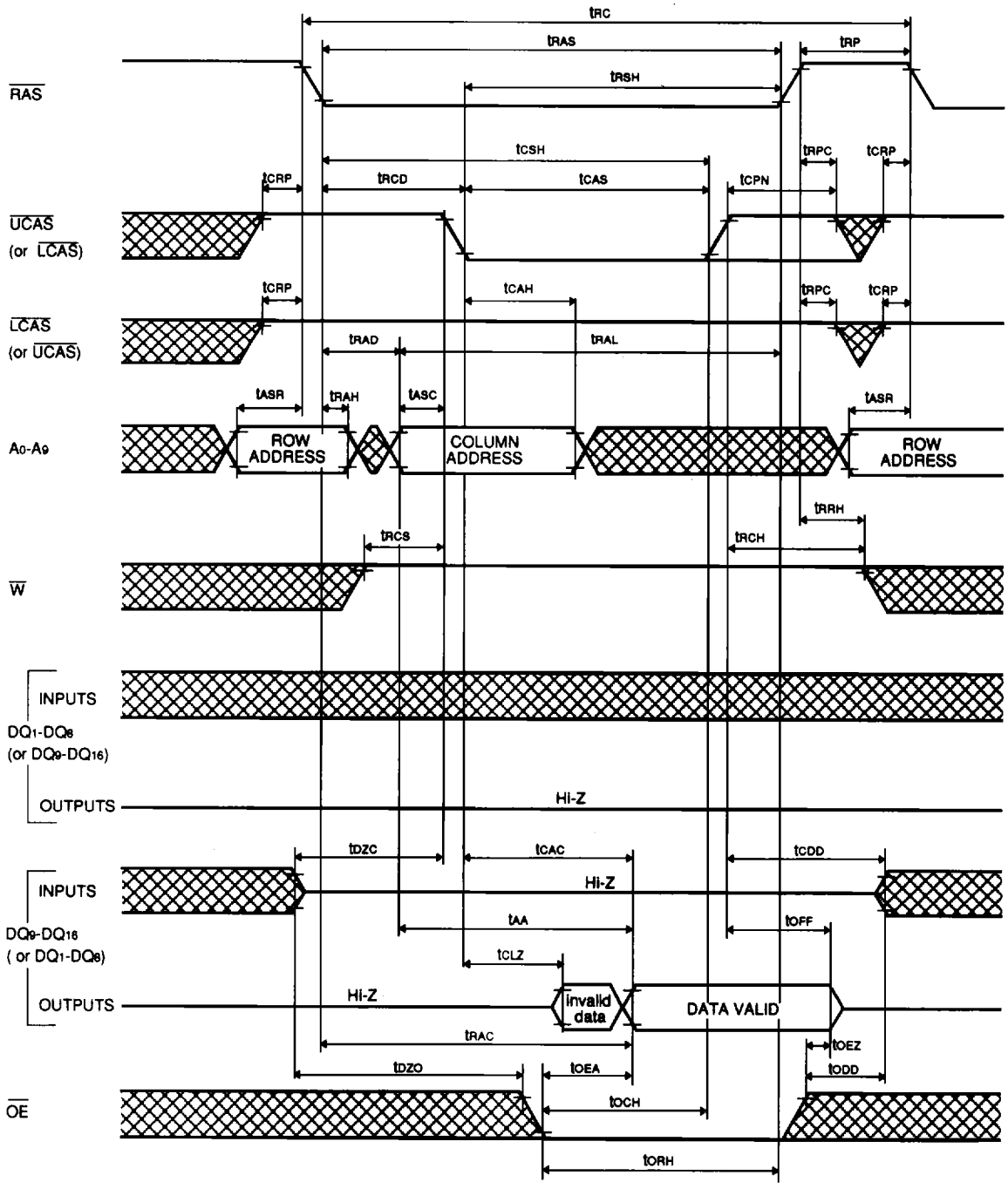
Note 28

Indicates the don't care input.
$V_{IH}(min.) \leq V_{IN} \leq V_{IH}(max)$ or $V_{IL}(min.) \leq V_{IN} \leq V_{IL}(max)$

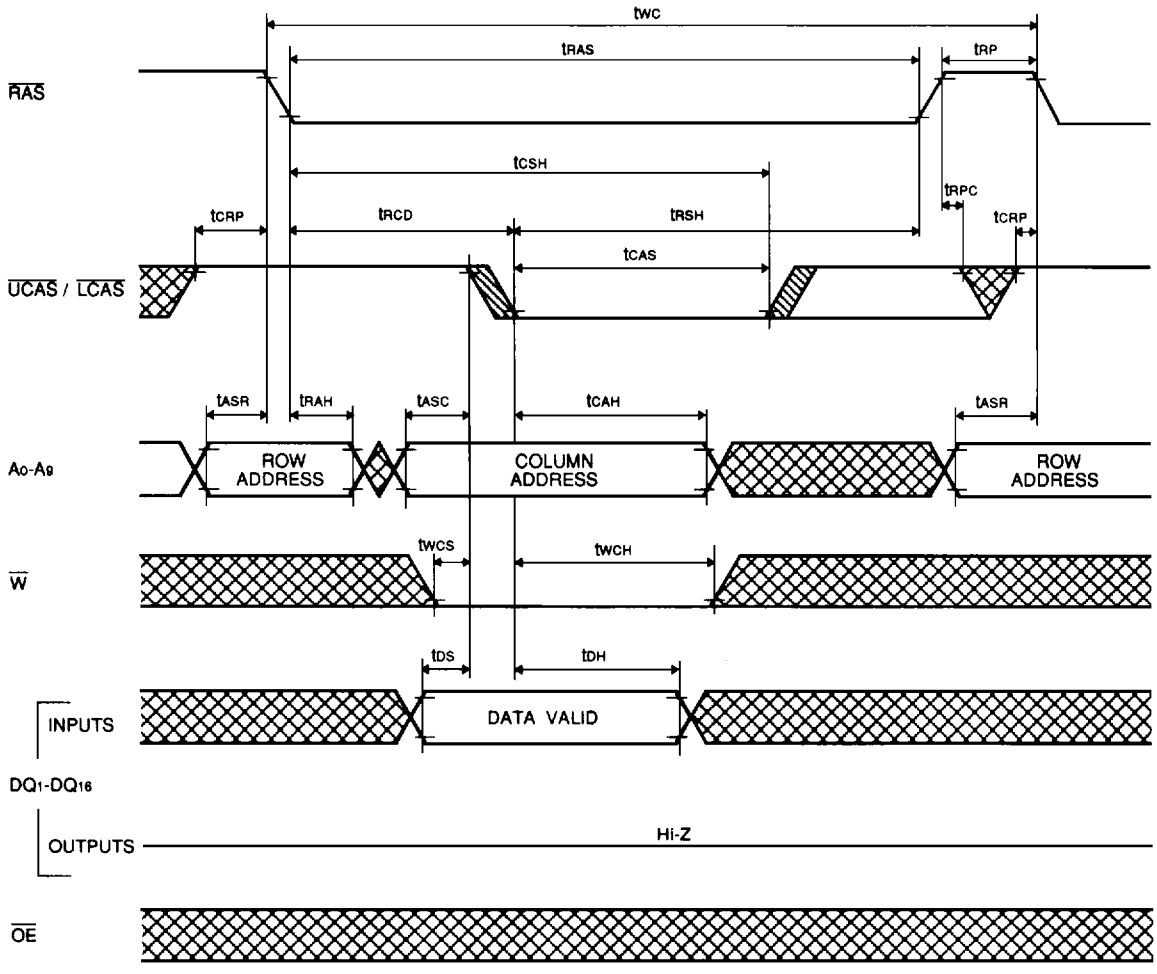
Indicates the invalid output.

Indicates the skew of the two inputs.

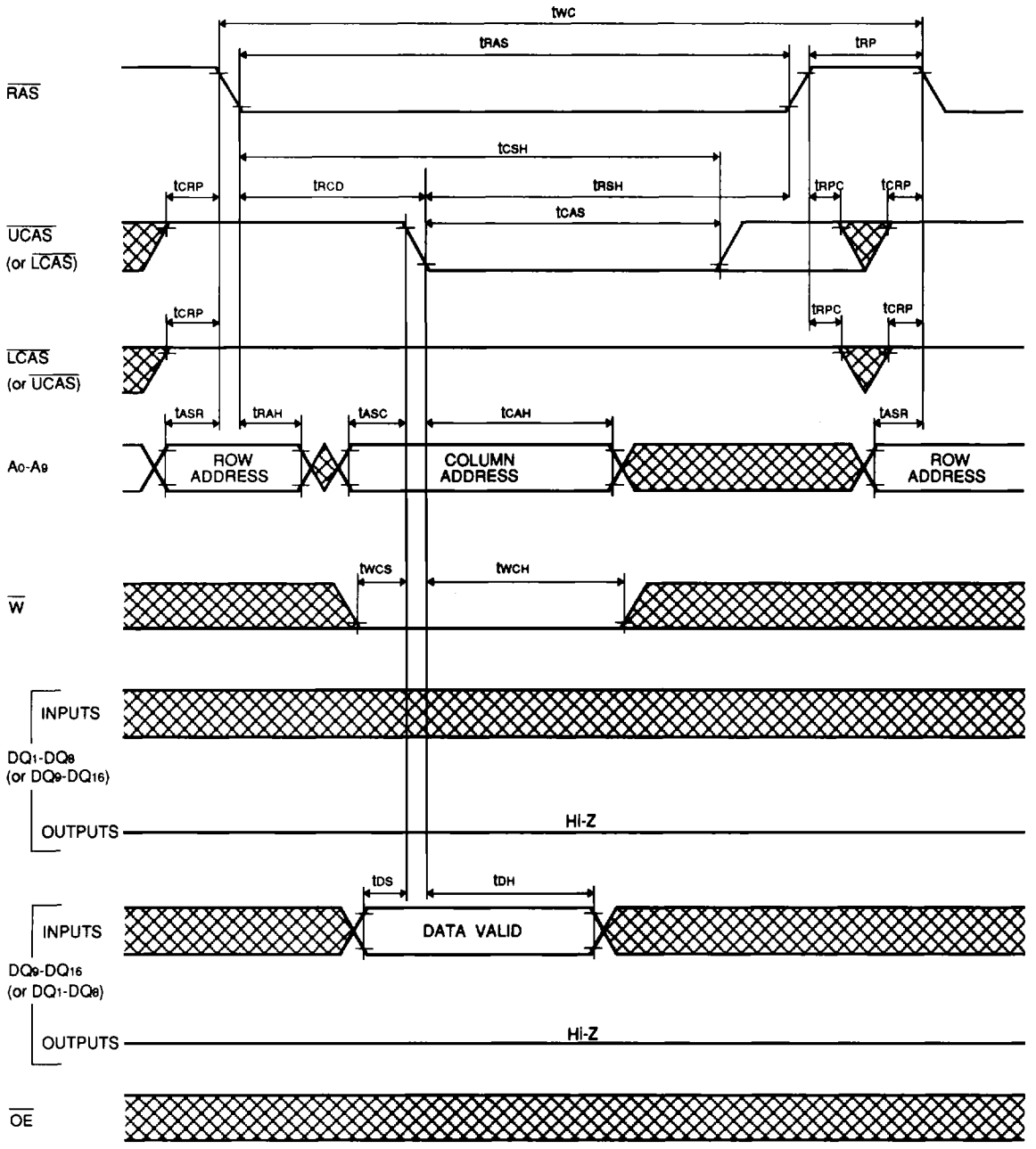
Upper / (Lower) Byte Read Cycle



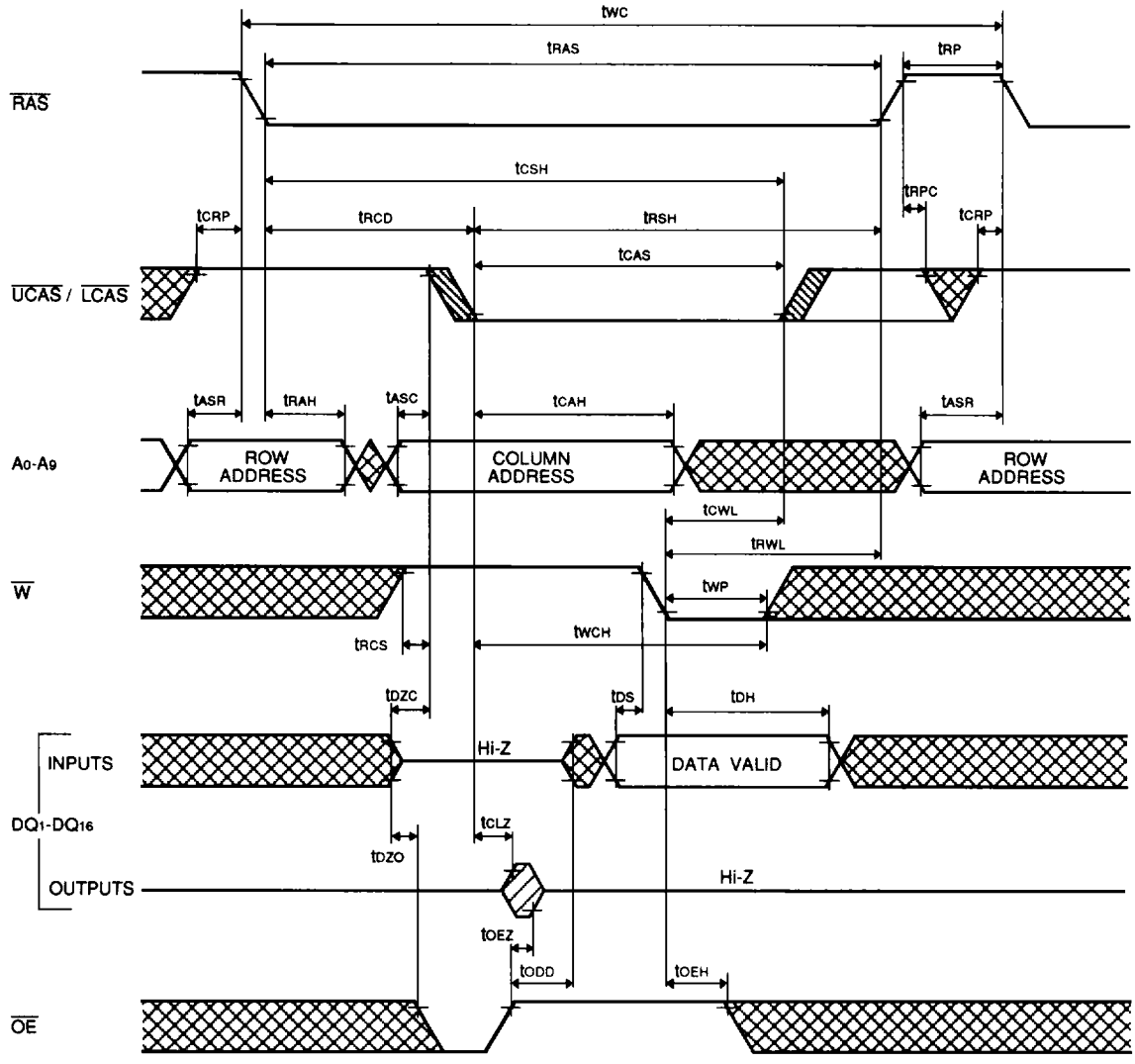
Write Cycle (Early write)



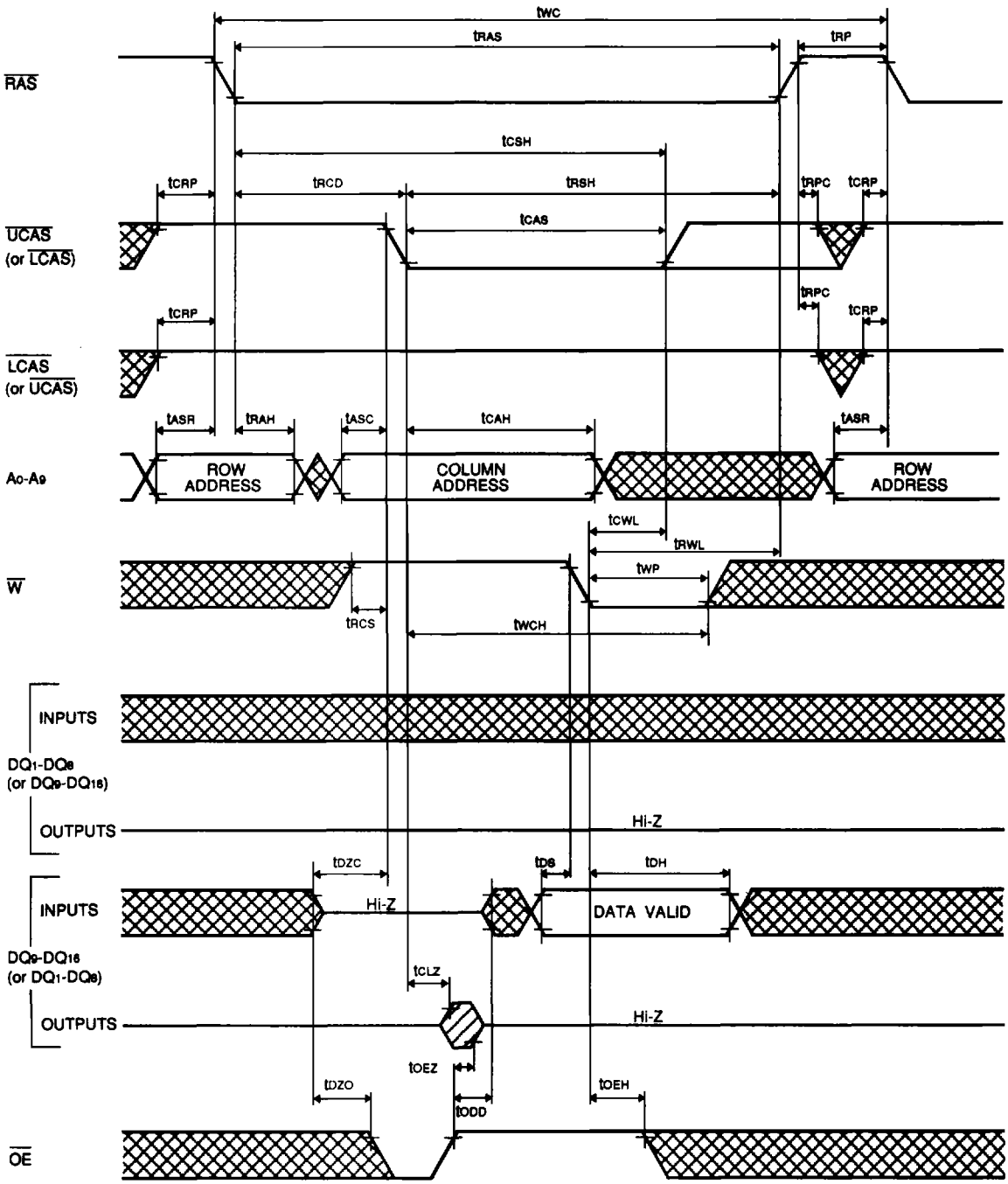
Upper/(Lower) Byte Write Cycle (Early write)



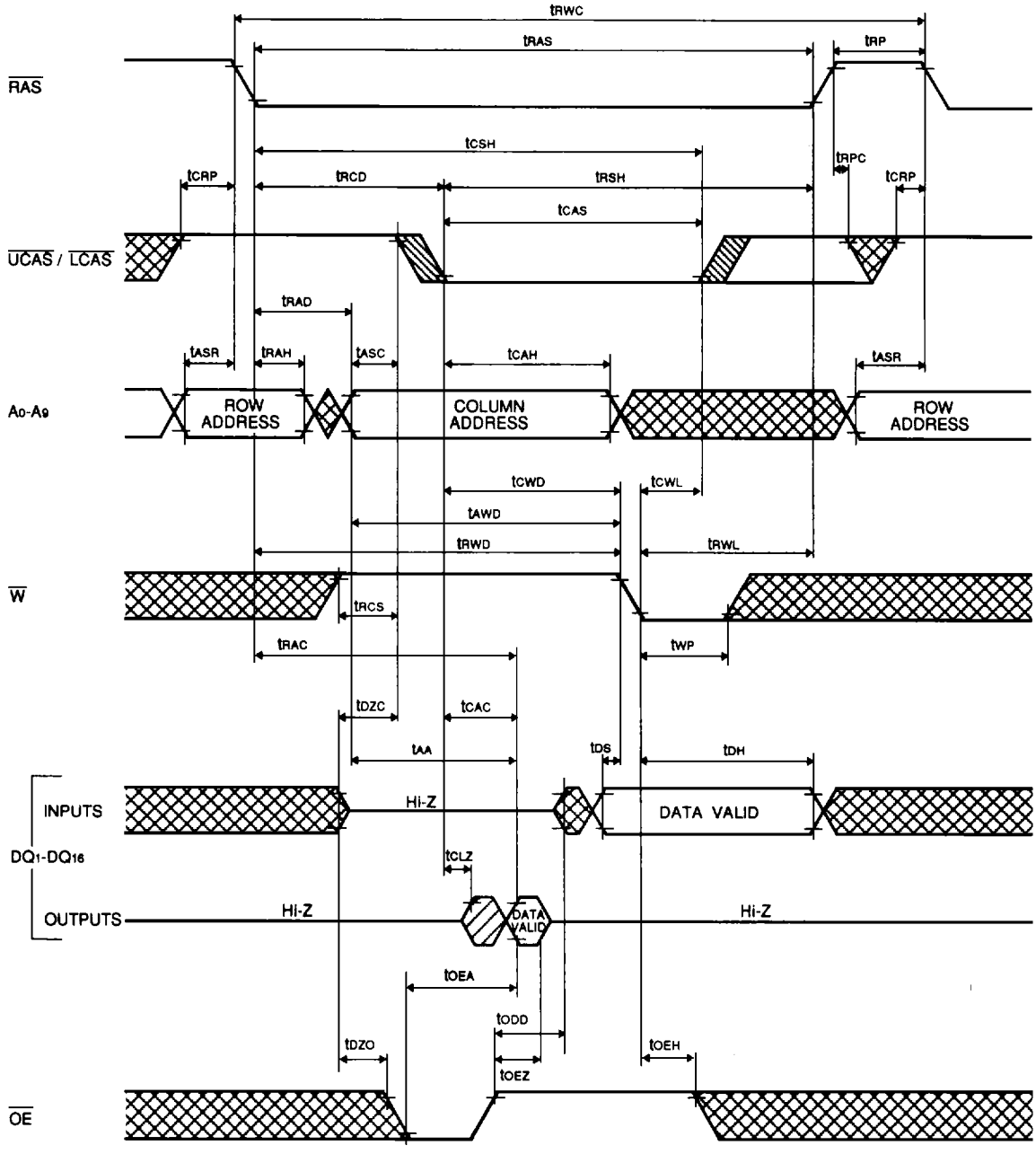
Write Cycle (Delayed write)



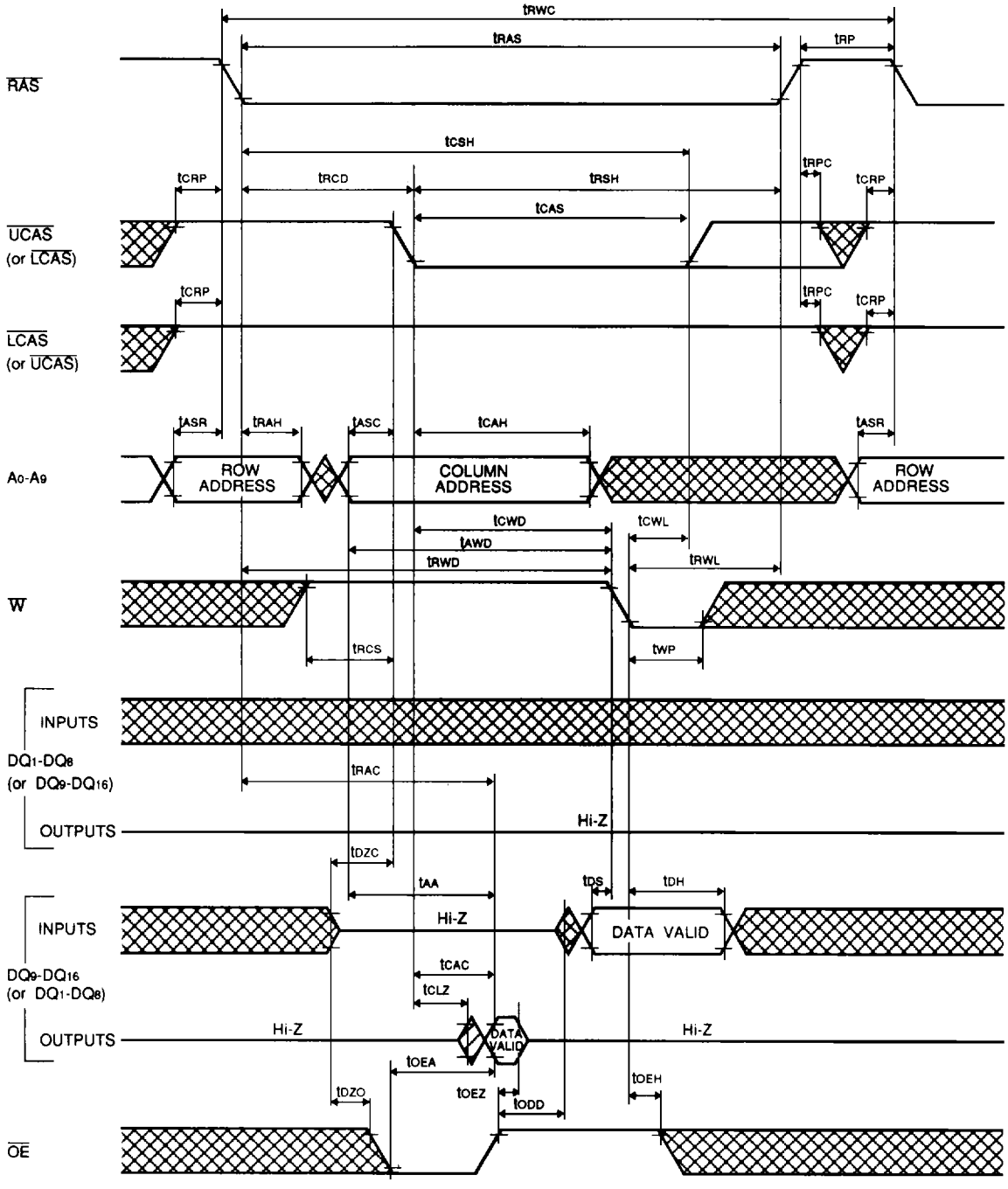
Upper/(Lower) Byte Write Cycle (Delayed write)



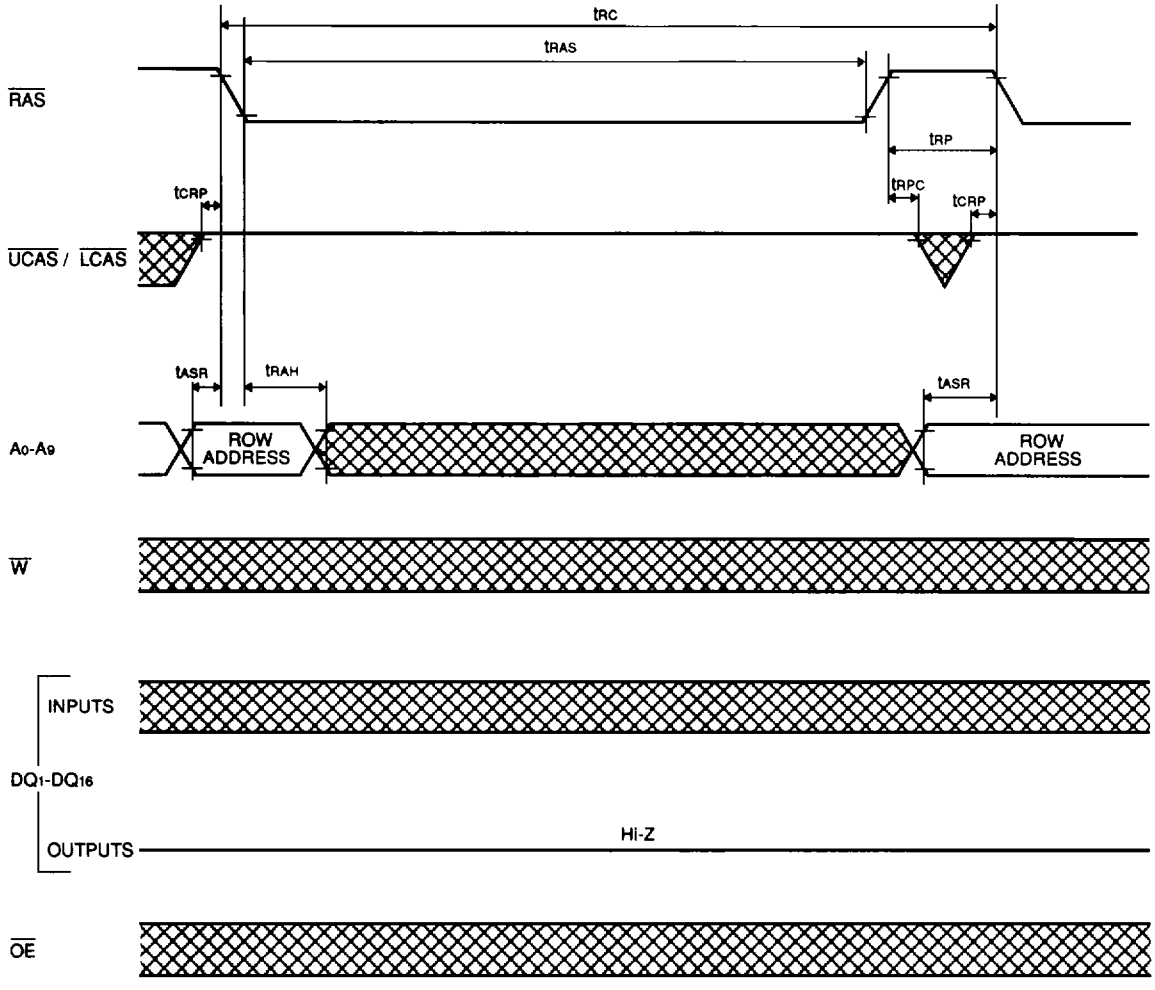
Read-Write, Read-Modify-Write Cycle



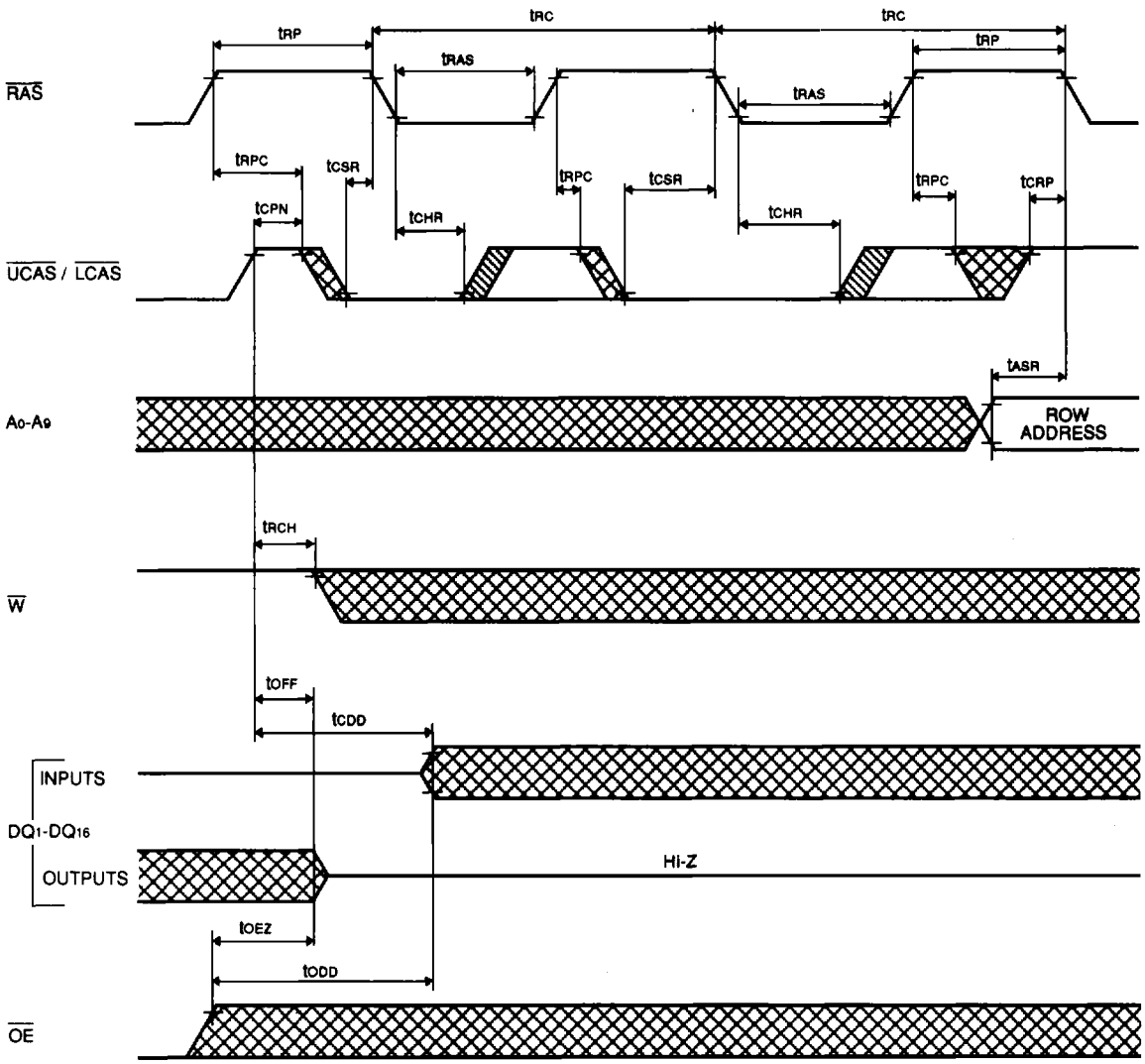
Read-Upper/(Lower) Write, Read-Modify-Upper/(Lower) Write Cycle



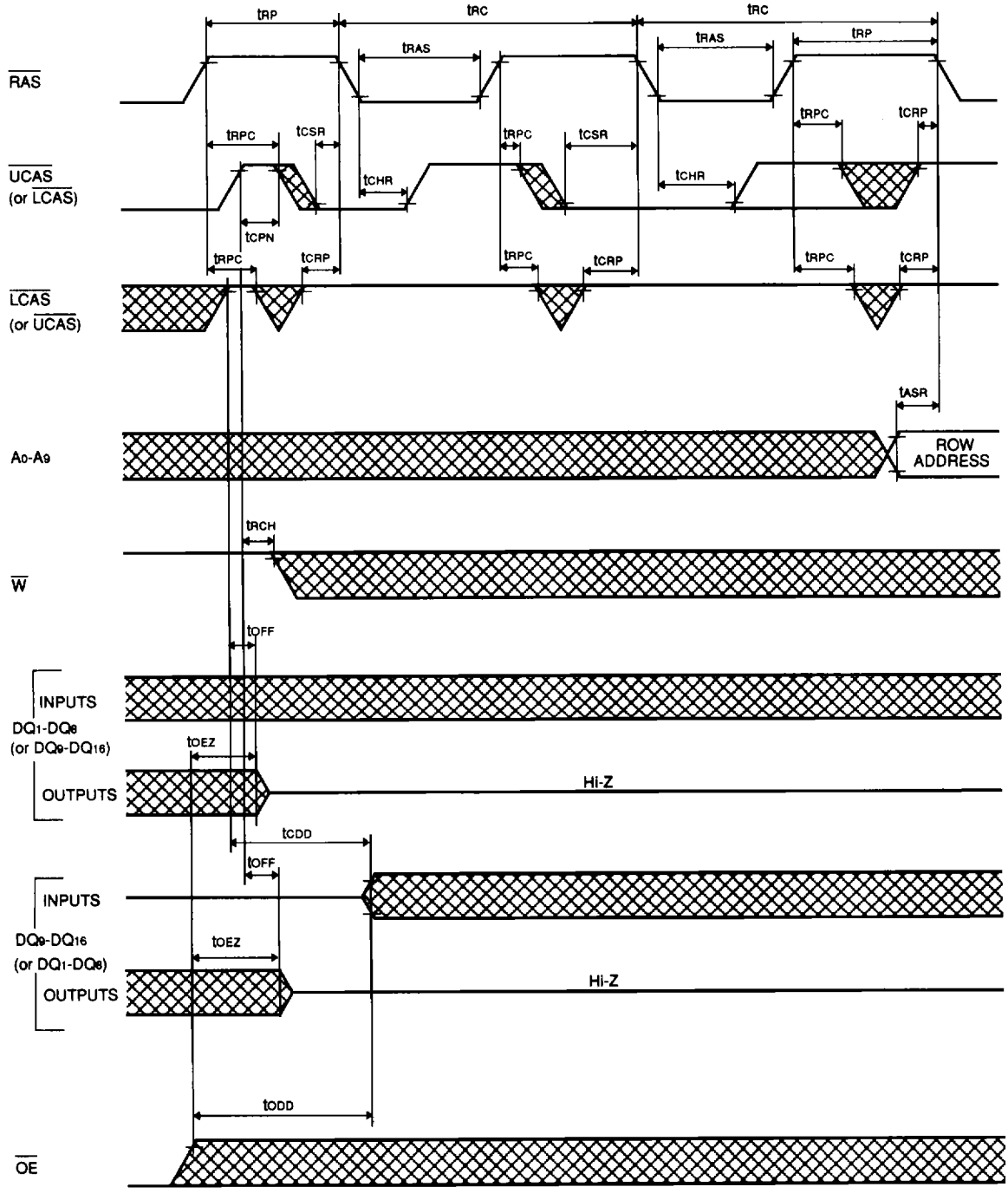
$\overline{RAS}$-only Refresh Cycle



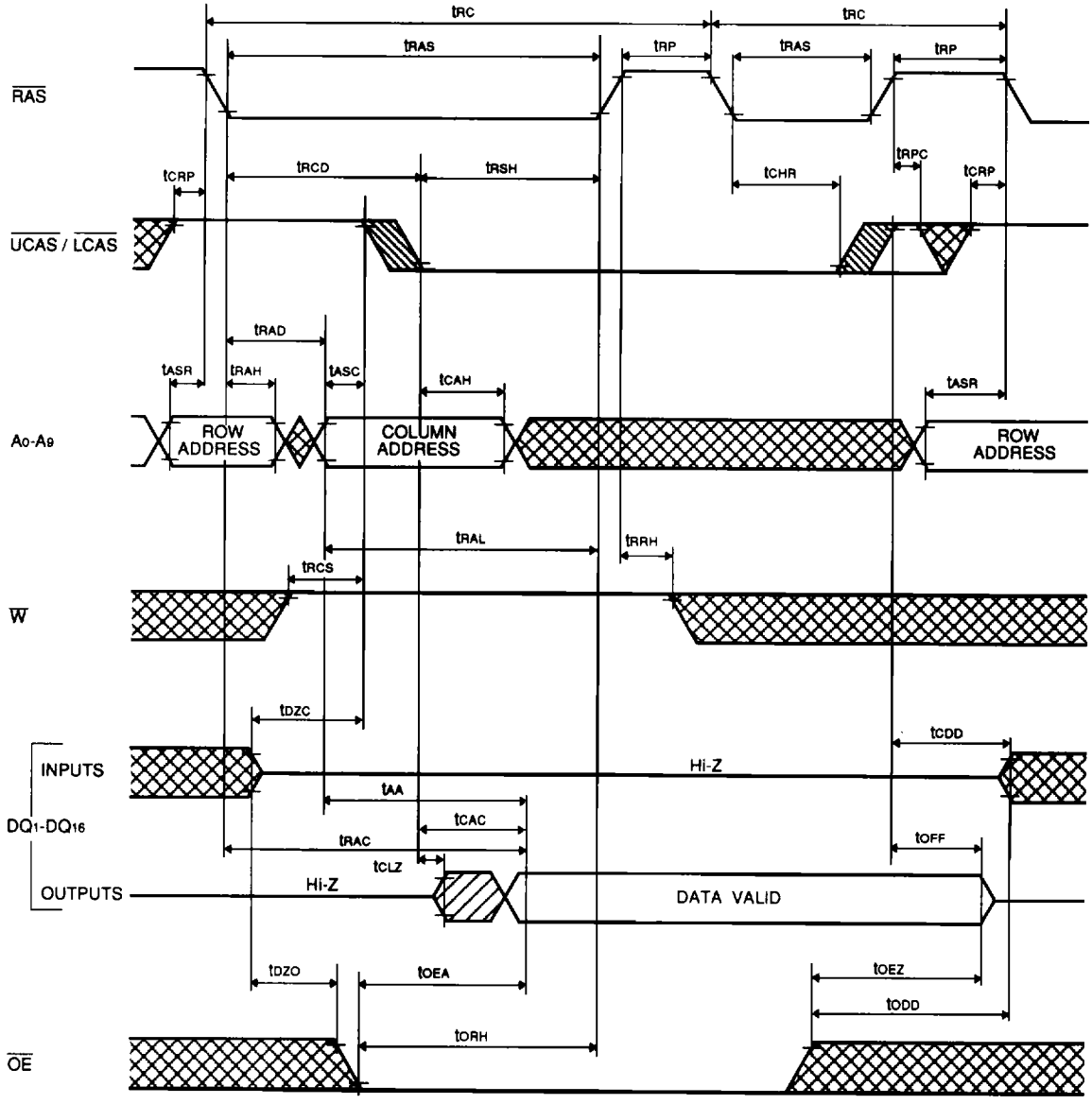
$\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle



Upper/(Lower) $\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle

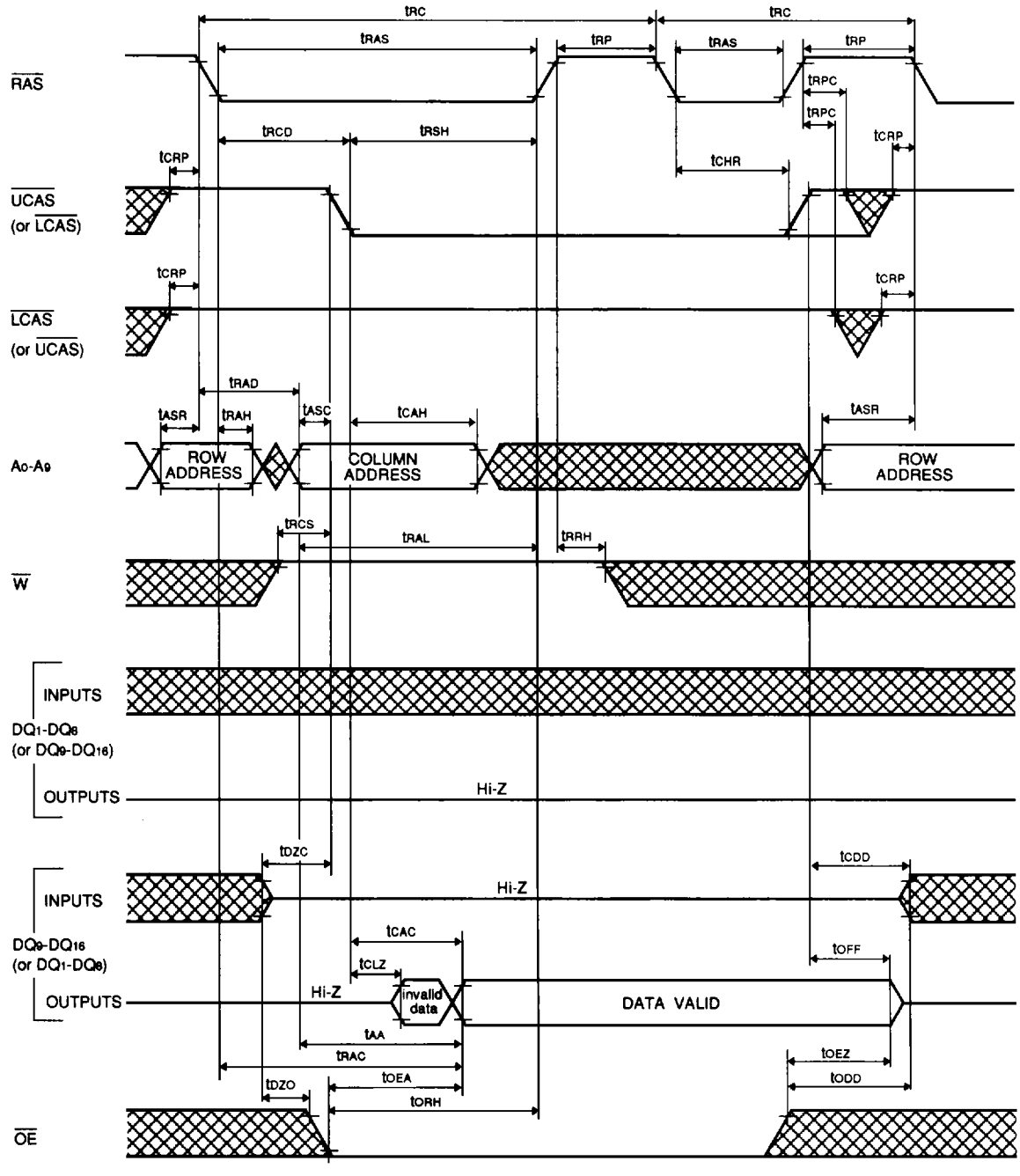


Hidden Refresh Cycle (Read) (Note 29)

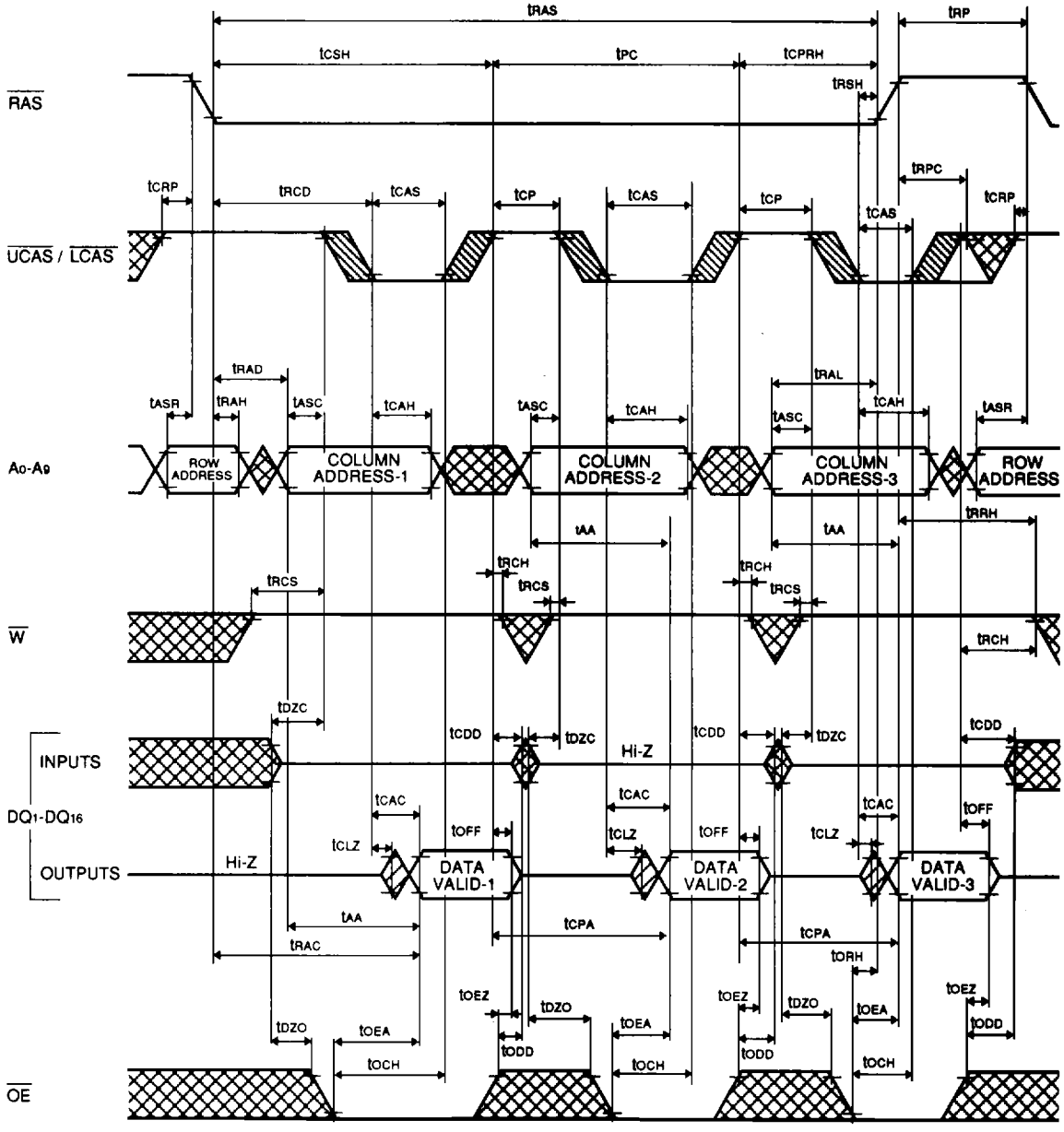


Note 29: Early write, delayed write, read write or read modify write cycle is applicable as well as read cycle.
Timing requirements and output state are the same as that of each cycle shown above.

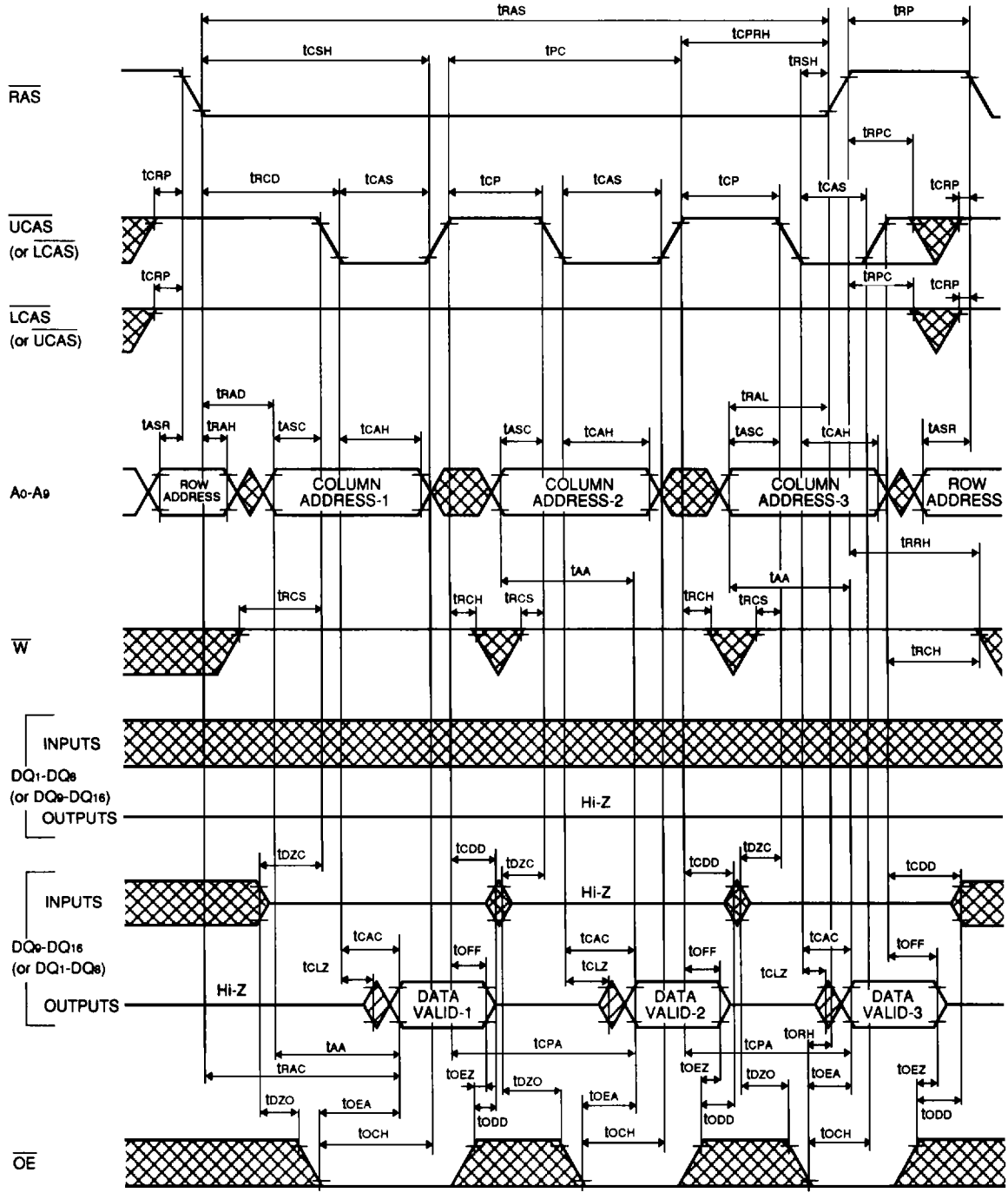
Upper/(Lower) Hidden Refresh Cycle (Byte Read) (Note 29)



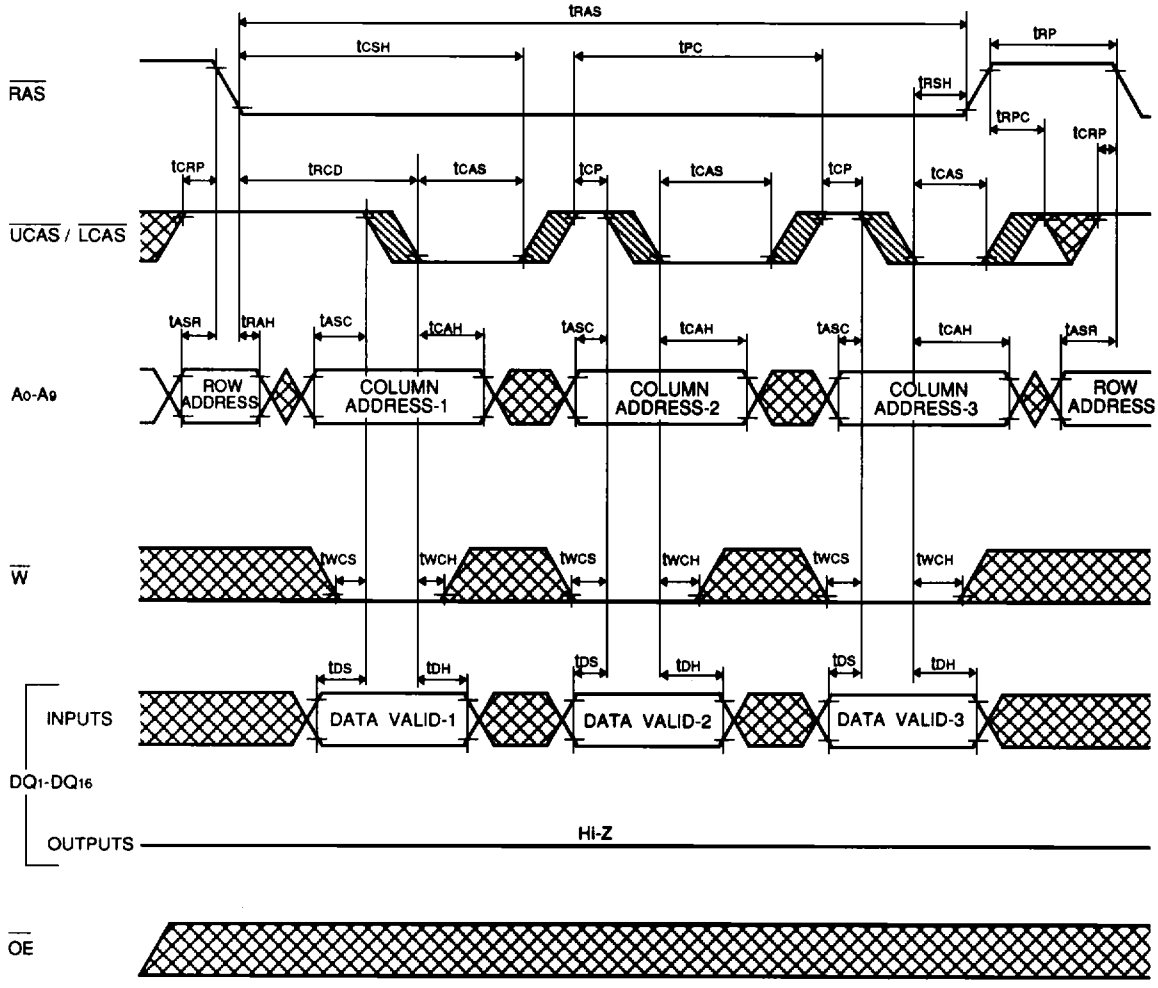
Fast Page Mode Read Cycle



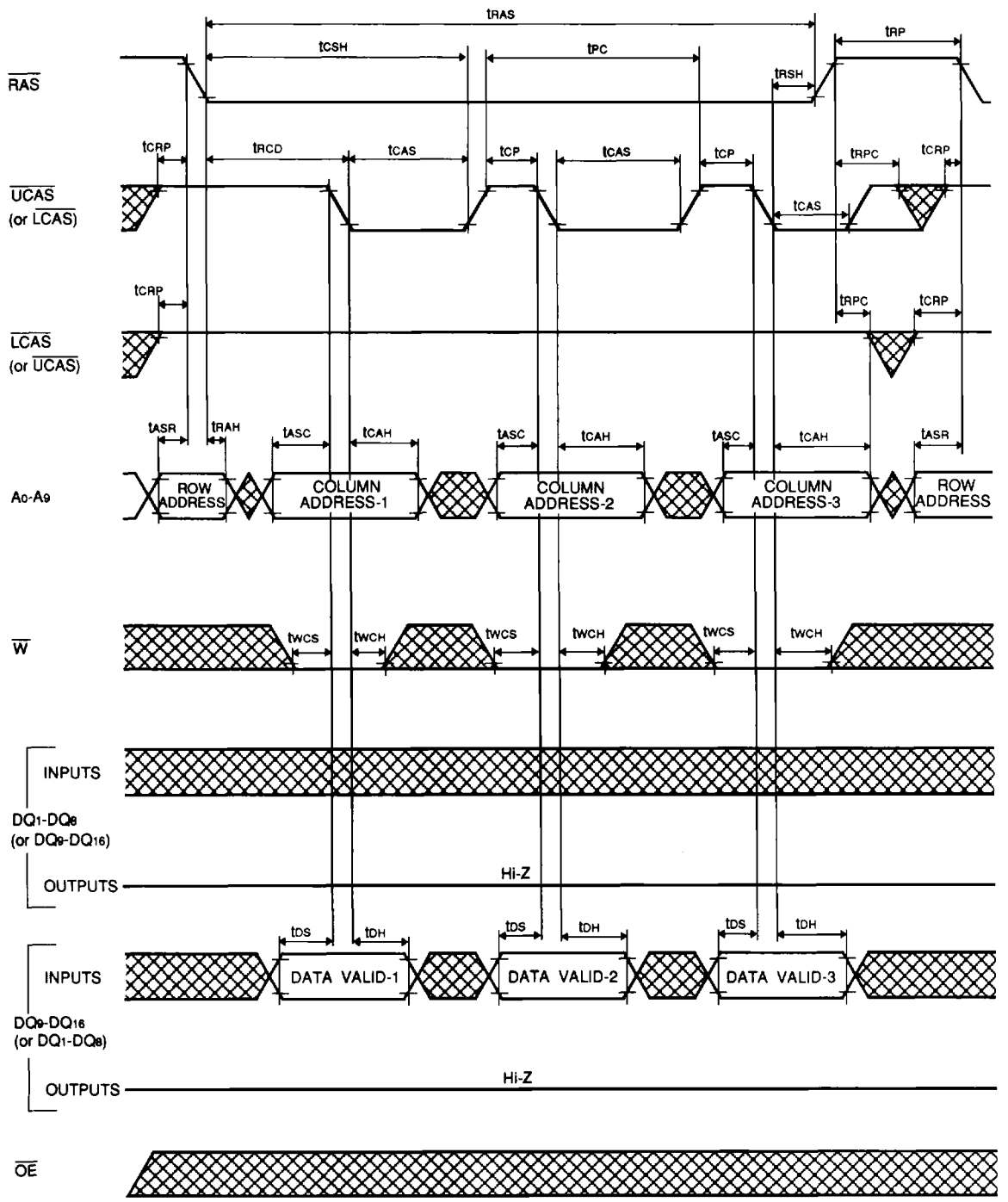
Upper/(Lower) Fast Page Mode Read Cycle



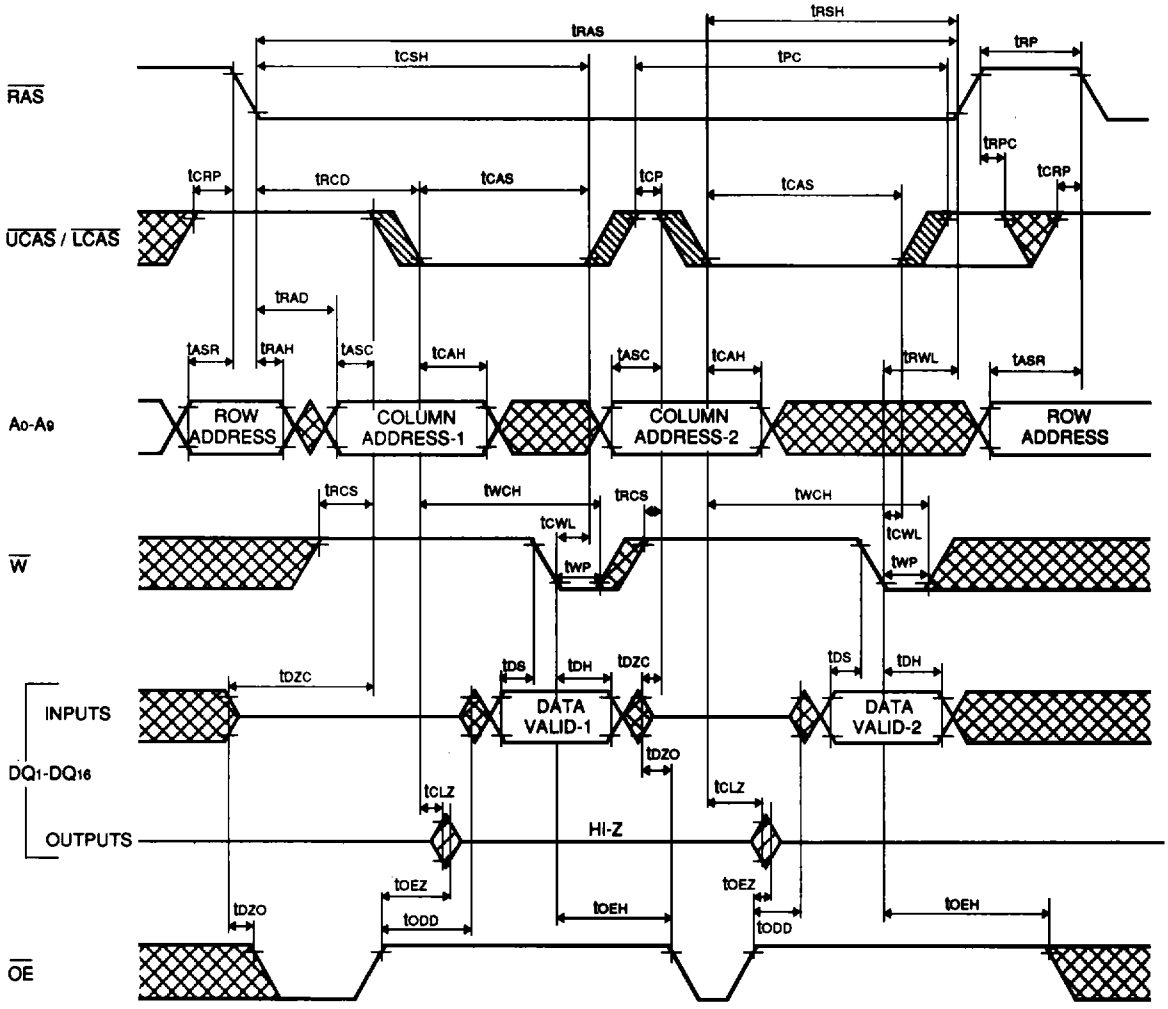
Fast Page Mode Write Cycle (Early Write)



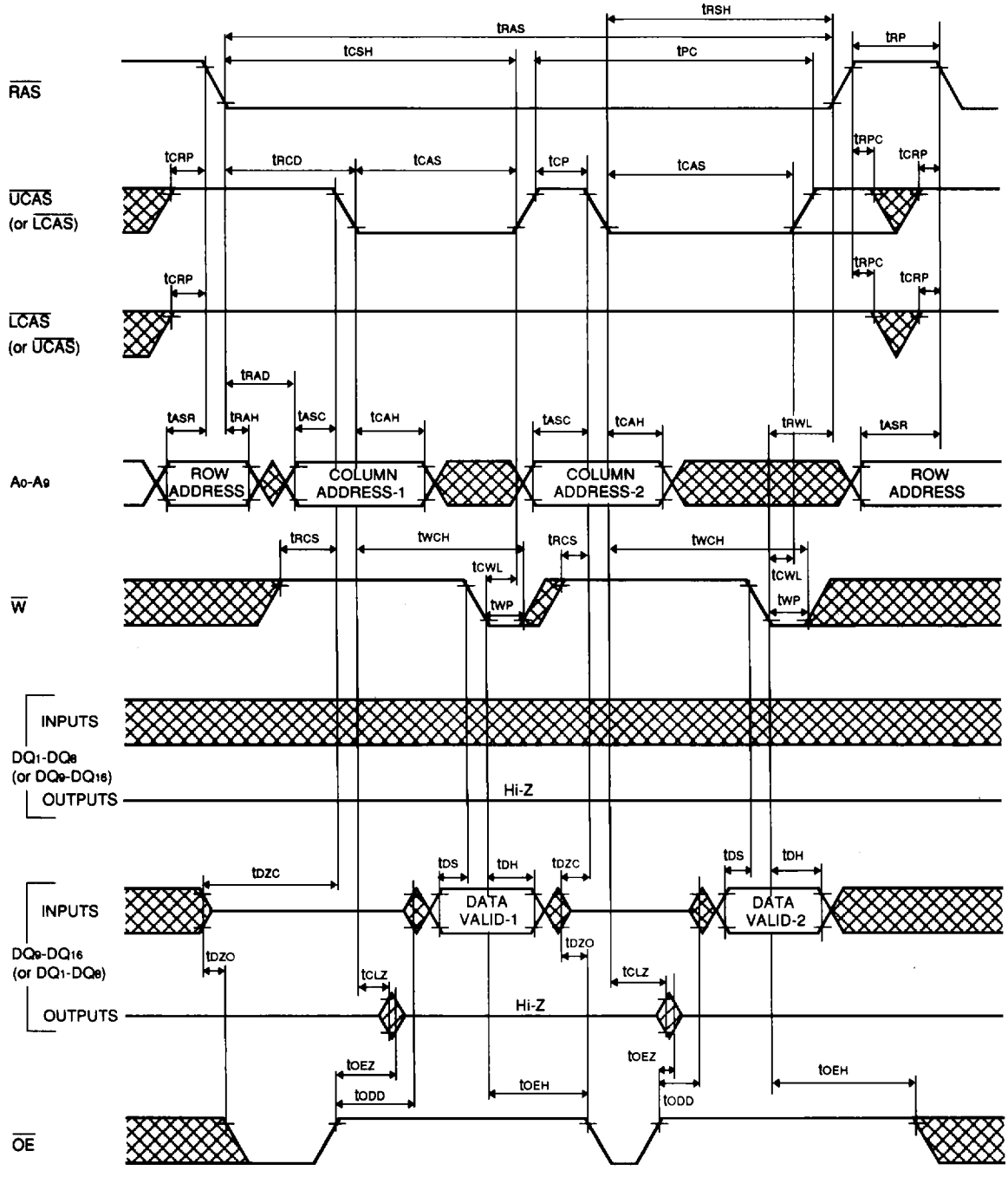
Fast Page Mode Upper/(Lower) Byte Write Cycle (Early Write)



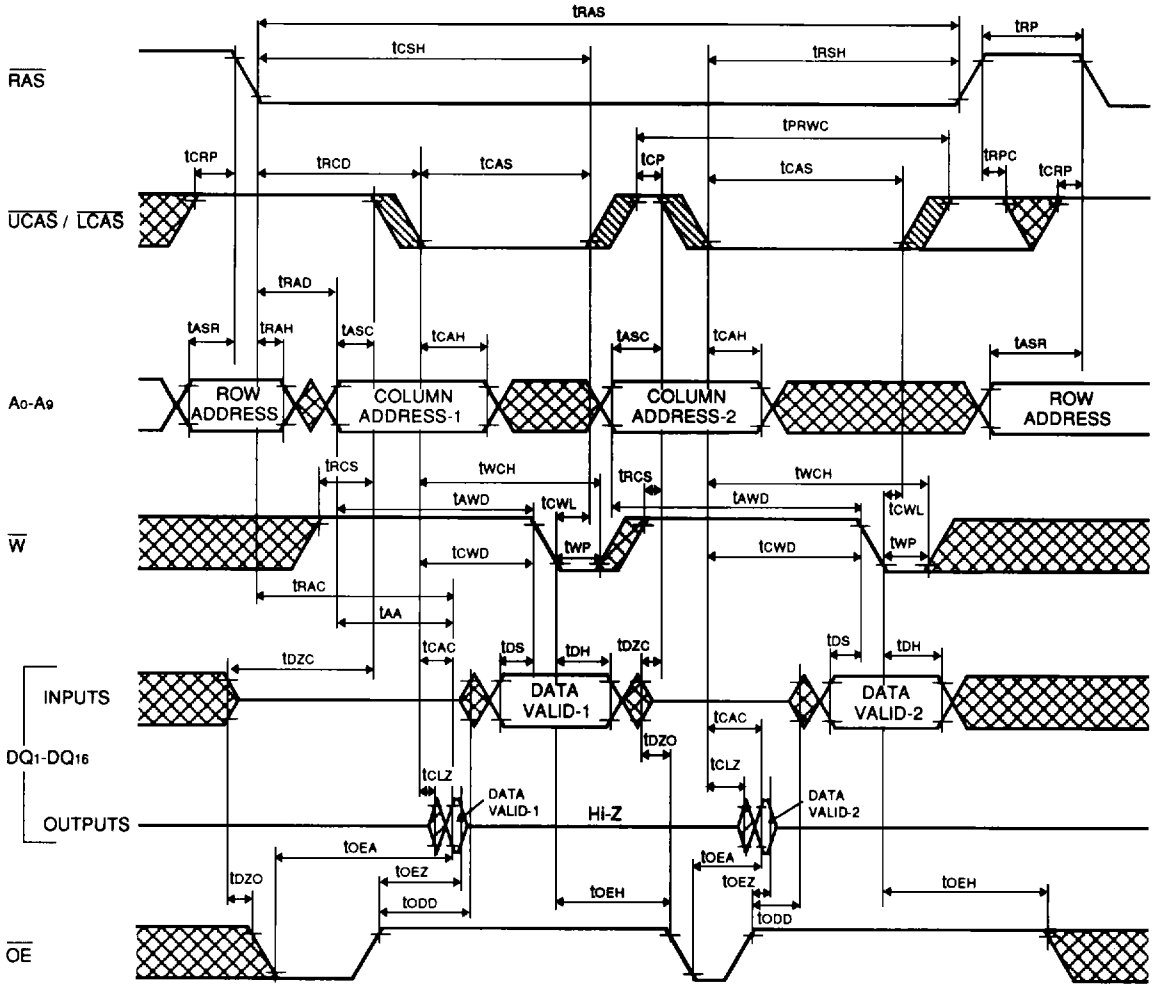
Fast Page Mode Write Cycle (Delayed Write)



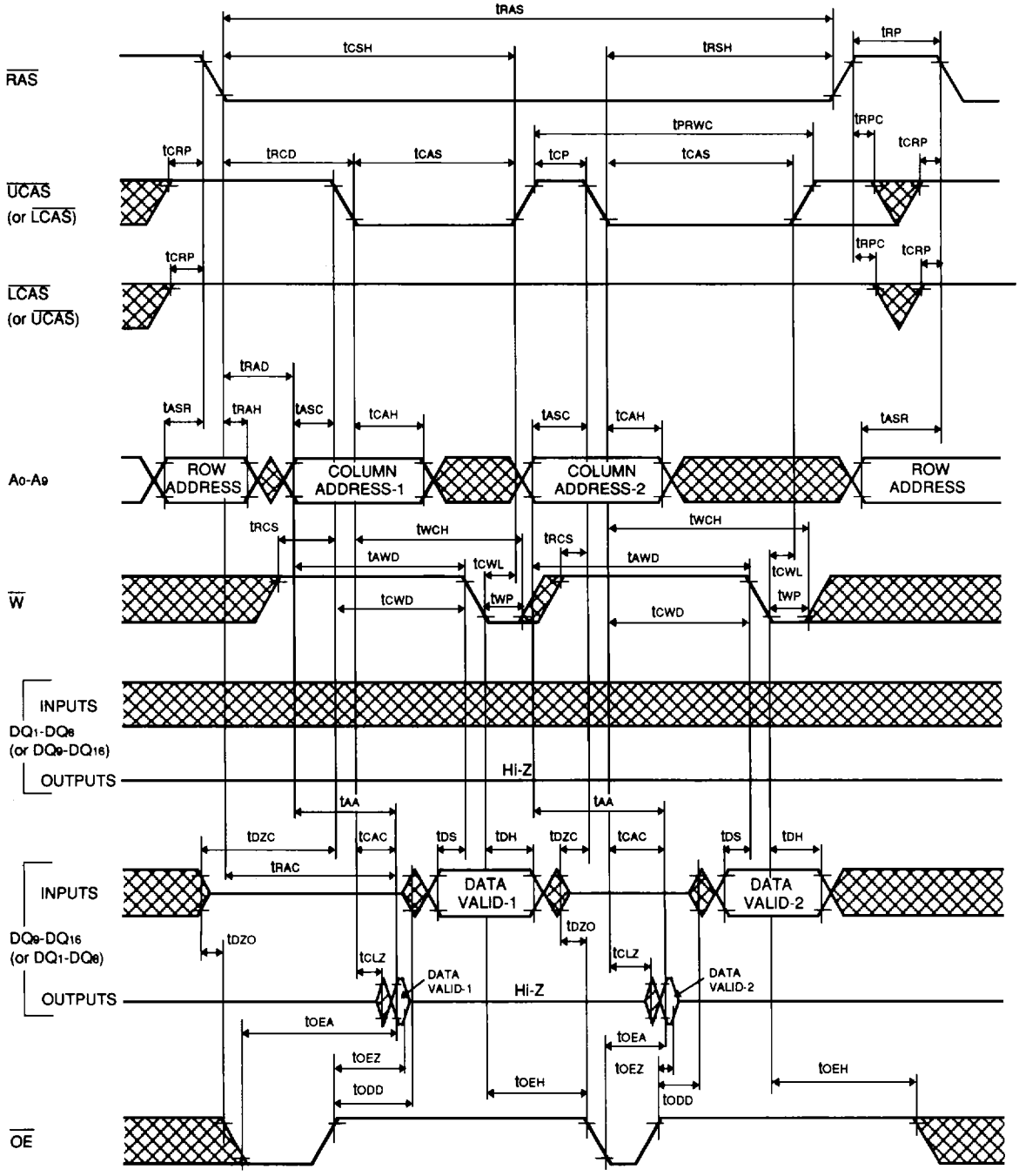
Fast Page Mode Upper / (Lower) Byte Write (Delayed Write)



Fast Page Mode Read-Write, Read-Modify-Write Cycle



Fast Page Mode Read-Upper/(Lower) Write, Read-Modify-Upper/(Lower) Write Cycle



SELF REFRESH SPECIFICATIONS

Self refresh devices are denoted by "S" after speed item, like -6S / -7S . The other characteristics and requirements than the below are same as normal devices.

ELECTRICAL CHARACTERISTICS (Ta=0 ~ 70°C, Vcc=3.3V± 0.3V, Vss=0V, unless otherwise noted) (Note 2)

Symbol	Parameter		Test conditions	Limits			Unit
				Min	Typ	Max	
I_{CC8}	Supply current from Vcc Extended refresh cycle	M5M4V18160B -6S,-7S	$\overline{RAS}$ cycling $\overline{CAS}$ ≤ 0.2V or $\overline{CAS}$ before $\overline{RAS}$ refresh cycling $\overline{W}$ ≤ 0.2V or ≥ Vcc - 0.2V $\overline{OE}$ ≤ 0.2V or ≥ Vcc - 0.2V A_0~A_8 ≤ 0.2V or ≥ Vcc - 0.2V DQ = open t_{REF} = 128ms t_{RAS} = t_{RAS} min~1 μs			300	μA
$I_{CC9\ (AV)}$	Average supply current from Vcc Self - Refresh cycle	M5M4V18160B -6S,-7S	$\overline{RAS}$ = $\overline{CAS}$ ≤ 0.2V			200	μA

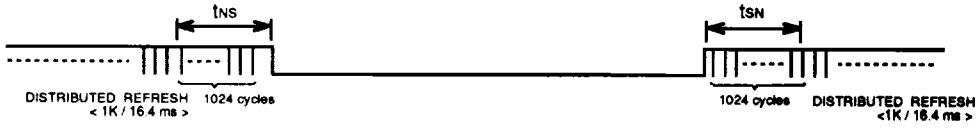
TIMING REQUIREMENTS (Ta=0 ~ 70°C, Vcc=3.3V ± 0.3V, Vss=0V, unless otherwise noted See notes 13,14)

Symbol	Parameter	Limits				Unit
		M5M4V18160B-6S		M5M4V18160B-7S		
		Min	Max	Min	Max	
t_{RASS}	Self Refresh $\overline{RAS}$ low pulse width	100		100		μs
t_{RPS}	Self Refresh $\overline{RAS}$ high precharge time	90		110		ns
t_{CHS}	Self Refresh $\overline{RAS}$ hold time	- 50		- 50		ns

SELF REFRESH ENTRY & EXIT CONDITIONS

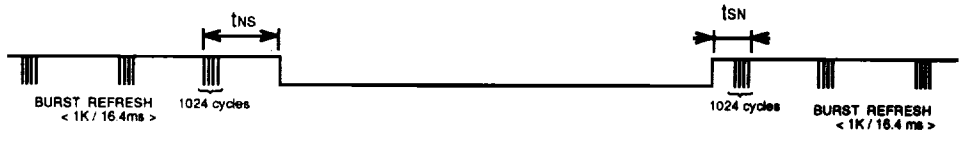
(1) In case of distributed refresh

The last / first full refresh cycles (1K) must be made within t_{NS} / t_{SN} before / after self refresh , on the condition of t_{NS} ≤ 16.4 ms and t_{SN} ≤ 16.4 ms.

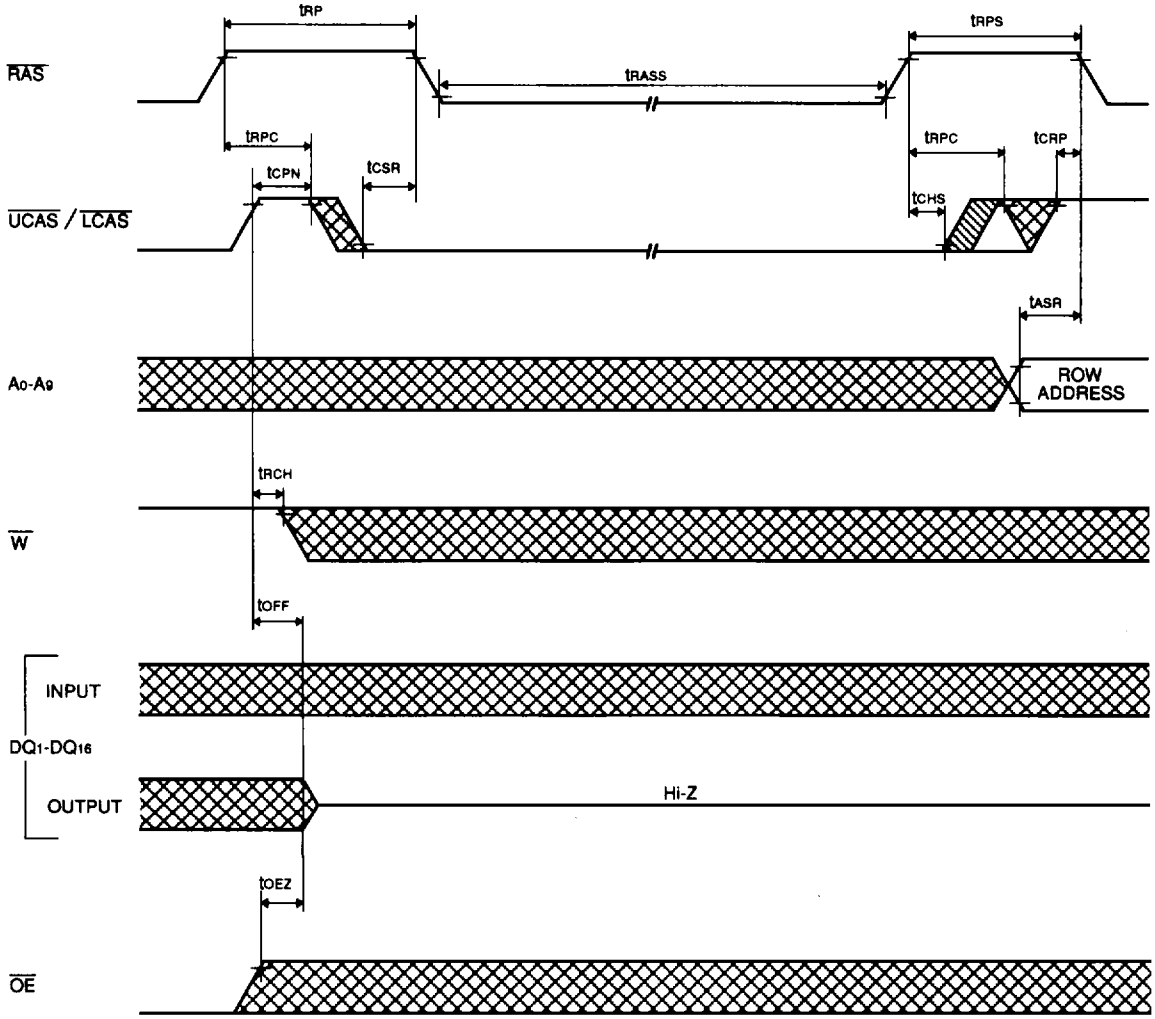


(2) In case of burst refresh

The last / first full refresh cycles (1K) must be made within t_{NS} / t_{SN} before / after self refresh , on the condition of t_{NS} + t_{SN} ≤ 16.4 ms.



Self Refresh Cycle



Upper/(Lower) Self Refresh Cycle*