1M/2M x 36 DRAM Module

Features

- 72-Pin Single-In-Line Memory Module
- Performance:

		-60	-70
t_{RAC}	$\overline{RAS}$ Access Time	60ns	70ns
t_{CAC}	$\overline{CAS}$ Access Time	15ns	20ns
t_{AA}	Access Time From Address	30ns	35ns
t_{RC}	Cycle Time	110ns	130ns
t_{PC}	Fast Page Mode Cycle Time	40ns	45ns

- High Performance CMOS process
- Single 5V, ± 0.5V Power Supply
- All inputs & outputs are fully TTL & CMOS compatible
- Low active current dissipation
- Fast Page Mode access cycle
- Refresh Modes: $\overline{RAS}$-Only, CBR, and Hidden Refresh
- 1024 refresh cycles distributed across 16ms
- 10/10 Addressing (Row/Column)
- Optimized for use in byte-write parity applications
- Gold and tin/lead tab versions available
- DRAMs in TSOP or SOJ packages; Quad CAS in SOJ only.

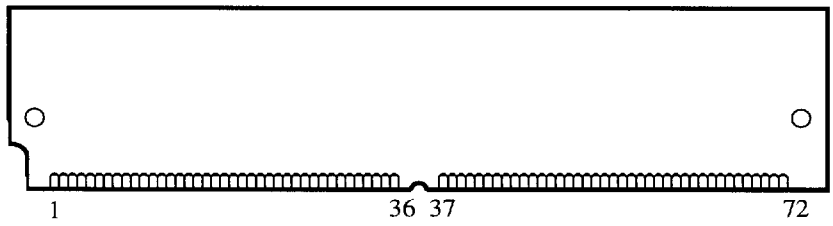
Description

The IBM11D2360Q is an 8MB 72-pin 4-byte single in-line memory module (SIMM). The module is organized as a 2Mx36 high speed memory array, and is configured as two 1Mx36 banks - each independently selectable via unique $\overline{RAS}$ inputs. The assembly is intended for use in 36 and 72 bit applications where interleave of 9 or 18 bit words is not required. It is manufactured with four 1Mx16 devices, each in a 400mil TSOP or SOJ package, and two 1Mx4 'Quad CAS' devices for parity. The use of 'Quad CAS' devices results in reduced SIMM height and lower power dissipation.

The IBM11D1360Q is a 4MB half populated version, manufactured with two 1Mx16 devices and one 1Mx4 'Quad CAS' device.

The IBM 72-Pin SIMMs provide a high performance, flexible 4-byte interface in a 4.25" long footprint.

Card Outline



Pin Description

$\overline{RAS}0$, $\overline{RAS}2$	Row Address Strobe (4MB)
$\overline{RAS}0$ - $\overline{RAS}3$	Row Address Strobe (8MB)
$\overline{CAS}0$ - $\overline{CAS}3$	Column Address Strobe
$\overline{WE}$	Read/write Input
A0 - A9	Address Inputs
DQ0-7, 9-16, 18-25, 27-34	Data Input/output
PQ8, 17, 26, 35	Parity Input/output
V_{CC}	Power (+5V)
V_{SS}	Ground
NC	No Connect
PD1 - PD4	Presence Detects

Pinout

Pin#	Name	Pin#	Name	Pin#	Name
1	V_{SS}	25	DQ24	49	DQ9
2	DQ0	26	DQ7	50	DQ27
3	DQ18	27	DQ25	51	DQ10
4	DQ1	28	A7	52	DQ28
5	DQ19	29	NC	53	DQ11
6	DQ2	30	V_{CC}	54	DQ29
7	DQ20	31	A8	55	DQ12
8	DQ3	32	A9	56	DQ30
9	DQ21	33	$\overline{RAS}3$*	57	DQ13
10	V_{CC}	34	$\overline{RAS}2$	58	DQ31
11	NC	35	PQ26	59	V_{CC}
12	A0	36	PQ8	60	DQ32
13	A1	37	PQ17	61	DQ14
14	A2	38	PQ35	62	DQ33
15	A3	39	V_{SS}	63	DQ15
16	A4	40	$\overline{CAS}0$	64	DQ34
17	A5	41	$\overline{CAS}2$	65	DQ16
18	A6	42	$\overline{CAS}3$	66	NC
19	NC	43	$\overline{CAS}1$	67	PD1
20	DQ4	44	$\overline{RAS}0$	68	PD2
21	DQ22	45	$\overline{RAS}1$*	69	PD3
22	DQ5	46	NC	70	PD4
23	DQ23	47	$\overline{WE}$	71	NC
24	DQ6	48	NC	72	V_{SS}

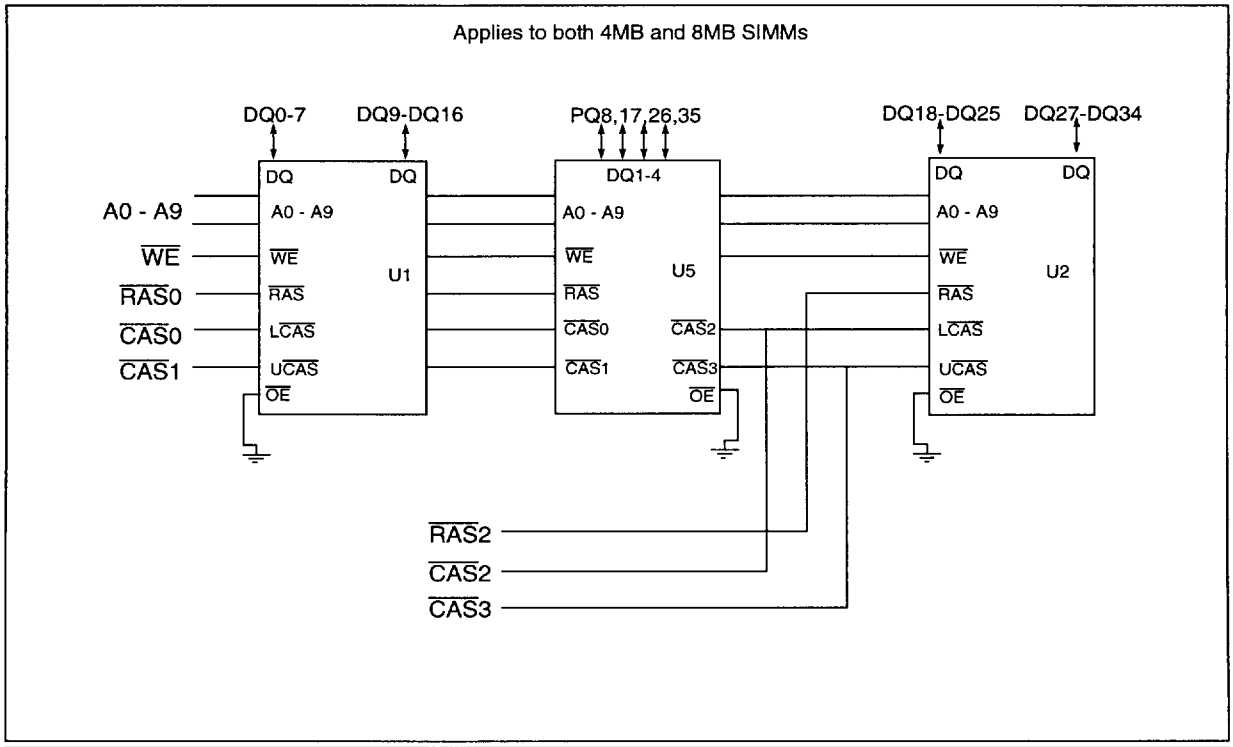
1. DQ numbering is compatible with non-parity (x32) version.
2. * $\overline{RAS}1$ and $\overline{RAS}3$ are "NC" on 4MB SIMM.

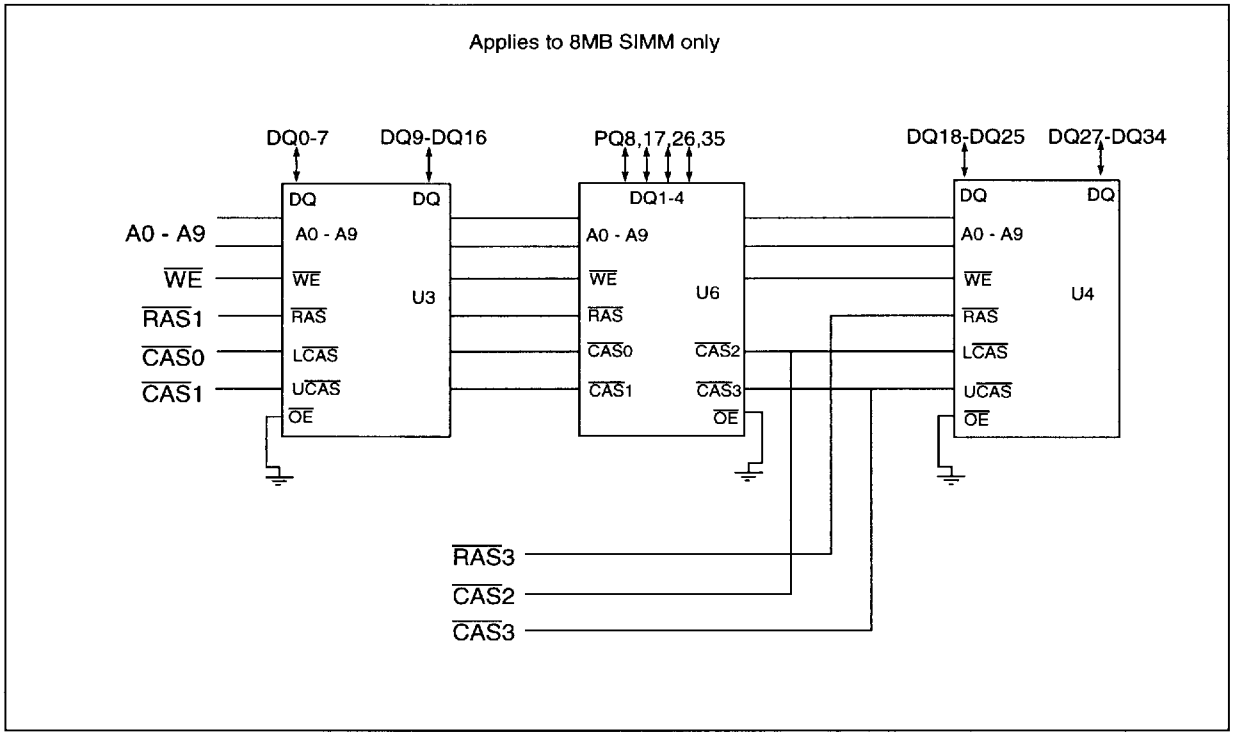
Ordering Information

Part Number	Organization	Speed	Addr.	Leads	Dimensions	DRAM Die Revision	1M x 16 Package	Notes
IBM11D1360QC-60	1M x 36	60ns	10/10	Sn/Pb	4.25" x 1" x .205"	D	TSOP	
IBM11D1360QC-70		70ns		Sn/Pb				
IBM11E1360QC-60		60ns		Au				
IBM11E1360QC-70		70ns		Au				
IBM11D1360QD-60J		60ns		Sn/Pb		E	SOJ	1
IBM11D1360QD-70J		70ns		Sn/Pb				1
IBM11D2360QC-60	2M x 36	60ns		Sn/Pb	4.25" x 1" x .360"	D	TSOP	
IBM11D2360QC-70		70ns		Sn/Pb				
IBM11E2360QC-60		60ns		Au				
IBM11E2360QC-70		70ns		Au				
IBM11D2360QD-60J		60ns		Sn/Pb		E	SOJ	1
IBM11D2360QD-70J		70ns		Sn/Pb				1
IBM11E2360QD-60J		60ns		Au				1
IBM11E2360QD-70J		70ns		Au				1

1. DRAM package designator appended to speed portion of part number on assemblies beginning with DRAM die rev E.

Block Diagrams





Truth Table

Function		$\overline{RAS}$	$\overline{CAS}$	$\overline{WE}$	Row Address	Column Address	All DQ, PQ bits
Standby		H	H→X	X	X	X	High Impedance
Read		L	L	H	Row	Col	Valid Data Out
Early-Write		L	L	L	Row	Col	Valid Data In
Fast Page Mode - Read: 1st Cycle		L	H→L	H	Row	Col	Valid Data Out
Subsequent Cycles		L	H→L	H	N/A	Col	Valid Data Out
Fast Page Mode - Write: 1st Cycle		L	H→L	L	Row	Col	Valid Data In
Subsequent Cycles		L	H→L	L	N/A	Col	Valid Data In
$\overline{RAS}$-Only Refresh		L	H	X	Row	N/A	High Impedance
$\overline{CAS}$-Before-$\overline{RAS}$ Refresh		H→L	L	H	X	X	High Impedance
Hidden Refresh	Read	L→H→L	L	H	Row	Col	Data Out
	Write	L→H→L	L	L	Row	Col	Data In

Presence Detect

Pin	1M x 36		2M x 36	
	-60	-70	-60	-70
PD1	V_{SS}	V_{SS}	NC	NC
PD2	V_{SS}	V_{SS}	NC	NC
PD3	NC	V_{SS}	NC	V_{SS}
PD4	NC	NC	NC	NC

1. NC= OPEN, V_{SS} = GND

Absolute Maximum Ratings

Symbol	Parameter	Rating	Units	Notes
V_{CC}	Power Supply Voltage	-1.0 to +6.0	V	1
V_{IN}	Input Voltage	-1.0 to +6.0	V	1
V_{OUT}	Output Voltage	-1.0 to +6.0	V	1
T_{OPR}	Operating Temperature	0 to +70	°C	1
T_{STG}	Storage Temperature	-55 to +125	°C	1
P_D	Power Dissipation	2.3 (4MB) 4.6 (8MB)	W	1, 2
I_{OUT}	Short Circuit Output Current	50	mA	1

1. Stresses greater than those listed may cause permanent damage to the device. This is a stress rating only, and device functional operation at or above the conditions indicated is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. Maximum power occurs when all banks are active (refresh cycle).

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

Symbol	Parameter	Min	Typ	Max	Units	Notes
V_{CC}	Supply Voltage	4.5	5.0	5.5	V	1
V_{IH}	Input High Voltage	2.4	—	V_{CC} + 0.5	V	1, 2
V_{IL}	Input Low Voltage	0.0	—	0.8	V	1, 2

1. All voltages referenced to V_{SS}.
2. V_{IH} may overshoot to V_{CC} + 2.0V for pulse widths of ≤ 4.0ns (or V_{CC} + 1.0V for ≤ 8.0ns). Additionally, V_{IL} may undershoot to -2.0V for pulse widths ≤ 4.0ns (or -1.0V for ≤ 8.0ns). Pulse widths measured at 50% points with amplitude measured peak to DC reference.

Capacitance (T_A = 0 to +70°C, V_{CC} = 5.0V ± 0.5V)

Symbol	Parameter	1M x 36 Max	2M x 36 Max	Units
C_{I1}	Input Capacitance (A0-A9)	58	100	pF
C_{I2}	Input Capacitance (4MB: $\overline{RAS}$0, 8MB: $\overline{RAS}$0, 1)	37	44	pF
C_{I3}	Input Capacitance (4MB: $\overline{RAS}$2, 8MB: $\overline{RAS}$2, 3)	30	42	pF
C_{I4}	Input Capacitance ($\overline{CAS}$)	25	47	pF
C_{I5}	Input Capacitance ($\overline{WE}$)	60	94	pF
$C_{I/O1}$	Output Capacitance (DQ0 - DQ34)	16	29	pF
$C_{I/O2}$	Output Capacitance (PQ8, 17, 26, 35))	18	29	pF

DC Electrical Characteristics (T_A = 0 to +70°C, V_{CC} = 5.0V ± 0.5V)

Symbol	Parameter		1M x 36 Min	1M x 36 Max	2M x 36 Min	2M x 36 Max	Units	Notes
I_{CC1}	Operating Current Average Power Supply Operating Current ($\overline{RAS}$, $\overline{CAS}$, Address Cycling: t_{RC} = t_{RC} min)	-60	—	415	—	421	mA	1, 2, 3
		-70	—	350	—	356		
I_{CC2}	Standby Current (TTL) Power Supply Standby Current ($\overline{RAS}$ = $\overline{CAS}$ ≥V_{IH})		—	6	—	12	mA	
I_{CC3}	$\overline{RAS}$ Only Refresh Current Average Power Supply Current, $\overline{RAS}$ Only Mode ($\overline{RAS}$ Cycling, $\overline{CAS}$ ≥V_{IH}: t_{RC} = t_{RC} min)	-60	—	415	—	421	mA	1, 3, 4
		-70	—	350	—	356		
I_{CC4}	Fast Page Mode Current Average Power Supply Current, Fast Page Mode ($\overline{RAS}$ = V_{IL}, $\overline{CAS}$, Address Cycling: t_{PC} = t_{PC} min)	-60	—	240	—	246	mA	1, 2, 3
		-70	—	220	—	226		
I_{CC5}	Standby Current (CMOS) Power Supply Standby Current ($\overline{RAS}$ = $\overline{CAS}$ = V_{CC} - 0.2V)		—	3	—	6	mA	
I_{CC6}	$\overline{CAS}$ Before $\overline{RAS}$ Refresh Current Average Power Supply Current, $\overline{CAS}$ Before $\overline{RAS}$ Mode ($\overline{RAS}$, $\overline{CAS}$, Cycling: t_{RC} = t_{RC} min)	-60	—	415	—	421	mA	1, 3, 4
		-70	—	350	—	356		
$I_{I(L)}$	Input Leakage Current Input Leakage Current, any input (0.0 ≤ V_{IN} ≤ (V_{CC} < 6.0V)) All Other Pins Not Under Test = 0V	$\overline{RAS}$0, 1	-20	+20	-20	+20	µA	
		$\overline{RAS}$2, 3	-10	+10	-10	+10		
		$\overline{CAS}$	-20	+20	-40	+40		
		All others	-30	+30	-60	+60		
$I_{O(L)}$	Output Leakage Current (D_{OUT} is disabled, 0.0 ≤ V_{OUT} ≤ V_{CC})		-10	+10	-20	+20	µA	
V_{OH}	Output High Level Output "H" Level Voltage (I_{OUT} = -5mA @ 2.4V)		2.4	—	2.4	—	V	
V_{OL}	Output Low Level Output "L" Level Voltage (I_{OUT} = +4.2mA @ 0.4V)		—	0.4	—	0.4	V	

1. I_{CC1}, I_{CC3}, I_{CC4} and I_{CC6} depend on cycle rate.
2. I_{CC1}, I_{CC4} depend on output loading. Specified values are obtained with the output open.
3. Address can be changed once or less while $\overline{RAS}$ = V_{IL}. In the case of I_{CC4}, it can be changed once or less when $\overline{CAS}$ = V_{IH}.
4. Refresh current is specified for 1 bank active and 1 bank standby.

AC Characteristics

(T_A = 0 to +70°C, V_{CC} = 5.0V ± 0.5V)

1. V_{IH} (min) and V_{IL} (max) are reference levels for measuring timing of input signals. Transition times are measured between V_{IH} and V_{IL}.
2. An initial pause of 100µs is required after power-up followed by 8 $\overline{RAS}$ only refresh cycles before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8 $\overline{CAS}$ before $\overline{RAS}$ refresh cycles instead of 8 $\overline{RAS}$ only refresh cycles is required.
3. AC measurements assume t_T = 5ns.
4. When $\overline{CAS}$0 and $\overline{CAS}$1, or $\overline{CAS}$2 and $\overline{CAS}$3 go low at the same time, all 16 bits of data are read/written into the DRAM. $\overline{CAS}$0 and $\overline{CAS}$1, or $\overline{CAS}$2 and $\overline{CAS}$3 ($\overline{CAS}$'s to the same DRAM) cannot be staggered within the same read/write cycle.

Read, Write, and Refresh Cycles (Common Parameters)

Symbol	Parameter	-60		-70		Units	Notes
		Min	Max	Min	Max		
t_{RC}	Random Read or Write Cycle Time	110	—	130	—	ns	
t_{RP}	$\overline{RAS}$ Precharge Time	40	—	50	—	ns	
t_{CP}	$\overline{CAS}$ Precharge Time	10	—	10	—	ns	1
t_{RAS}	$\overline{RAS}$ Pulse Width	60	10K	70	10K	ns	
t_{CAS}	$\overline{CAS}$ Pulse Width	15	10K	20	10K	ns	
t_{ASR}	Row Address Setup Time	0	—	0	—	ns	
t_{RAH}	Row Address Hold Time	10	—	10	—	ns	
t_{ASC}	Column Address Setup Time	0	—	0	—	ns	
t_{CAH}	Column Address Hold Time	10	—	10	—	ns	
t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	20	45	20	50	ns	2
t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	15	30	15	35	ns	3
t_{RSH}	$\overline{RAS}$ Hold Time	15	—	20	—	ns	
t_{CSH}	$\overline{CAS}$ Hold Time	60	—	70	—	ns	
t_{CRP}	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5	—	5	—	ns	
t_{DZC}	$\overline{CAS}$ Delay Time from D_{IN}	0	—	0	—	ns	
t_T	Transition Time (Rise and Fall)	3	50	3	50	ns	
t_{CLCH}	Hold Time $\overline{CAS}$ Low to $\overline{CAS}$ High	10	—	10	—	ns	4
t_{AR}	Column Address Hold Time Referenced to $\overline{RAS}$	—	—	—	—	ns	5

1. Last rising $\overline{CAS}$x edge to first falling $\overline{CAS}$x edge.
2. 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}.
3. 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}.
4. Last falling $\overline{CAS}$x edge to first rising $\overline{CAS}$x edge.
5. This timing parameter is not applicable to this product, but applies to a related product in this family.

Write Cycle

Symbol	Parameter	-60		-70		Units	Notes
		Min	Max	Min	Max		
t_{WCS}	Write Command Set Up Time	0	—	0	—	ns	1
t_{WCH}	Write Command Hold Time	10	—	15	—	ns	
t_{WP}	Write Command Pulse Width	10	—	15	—	ns	
t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	15	—	20	—	ns	3
t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	15	—	20	—	ns	3
t_{DS}	D_{IN} Setup Time	0	—	0	—	ns	2
t_{DH}	D_{IN} Hold Time	12	—	12	—	ns	2

1. t_{WCS}, t_{RWD}, t_{CWD}, t_{AWD}, and t_{CPW} are not restrictive parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$(min.), the entire cycle is an early write cycle and the data pin will remain open circuit (high impedance) through the entire cycle; If $t_{RWD} \geq t_{RWD}$(min.), $t_{CWD} \geq t_{CWD}$(min.), $t_{AWD} \geq t_{AWD}$(min.) and $t_{CPW} \geq t_{CPW}$(min.)(Fast Page Mode), the cycle is a Read-Modify-Write cycle and the data will contain read from the selected cell: If neither of the above sets of conditions are met, the condition of the data (at access time) is indeterminate.
2. Data-in set-up and hold is measured from the latter of the two timings, $\overline{CAS}$ or $\overline{WE}$.
3. This timing parameter is not applicable to this product, but applies to a related product in this family.

Read Cycle

Symbol	Parameter	-60		-70		Units	Notes
		Min	Max	Min	Max		
t_{RAC}	Access Time from $\overline{RAS}$	—	60	—	70	ns	1, 2, 3
t_{CAC}	Access Time from $\overline{CAS}$	—	15	—	20	ns	1, 3
t_{AA}	Access Time from Address	—	30	—	35	ns	2, 3
t_{RCS}	Read Command Setup Time	0	—	0	—	ns	
t_{RCH}	Read Command Hold Time to $\overline{CAS}$	0	—	0	—	ns	4
t_{RRH}	Read Command Hold Time to $\overline{RAS}$	0	—	0	—	ns	4
t_{RAL}	Column Address to $\overline{RAS}$ Lead Time	30	—	35	—	ns	
t_{CAL}	Column Address to $\overline{CAS}$ Lead Time	30	—	35	—	ns	
t_{CLZ}	$\overline{CAS}$ to Output in Low-Z	0	—	0	—	ns	
t_{OH}	Output Data Hold Time	3	—	3	—	ns	
t_{CDD}	$\overline{CAS}$ to D_{IN} Delay Time	15	—	20	—	ns	
t_{OFF}	Output Buffer Turn-off Delay	—	15	—	15	ns	5

1. Operation within the t_{RCD}(max) limit ensures that t_{RAC}(max) can be met. The 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}.
2. Operation within the t_{RAD}(max) limit ensures that t_{RAC}(max) can be met. The 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}.
3. Measured with the specified current load and 100pF.
4. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
5. t_{OFF} (max) defines the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.

Fast Page Mode Cycle

Symbol	Parameter	-60		-70		Units	Notes
		Min	Max	Min	Max		
t_{PC}	Fast Page Mode Cycle Time	40	—	45	—	ns	
t_{RASP}	Fast Page Mode $\overline{RAS}$ Pulse Width	60	100K	70	100K	ns	
t_{CPRH}	$\overline{RAS}$ Hold Time from $\overline{CAS}$ Precharge	35	—	40	—	ns	
t_{CPA}	Access Time from $\overline{CAS}$ Precharge	—	35	—	40	ns	1, 2

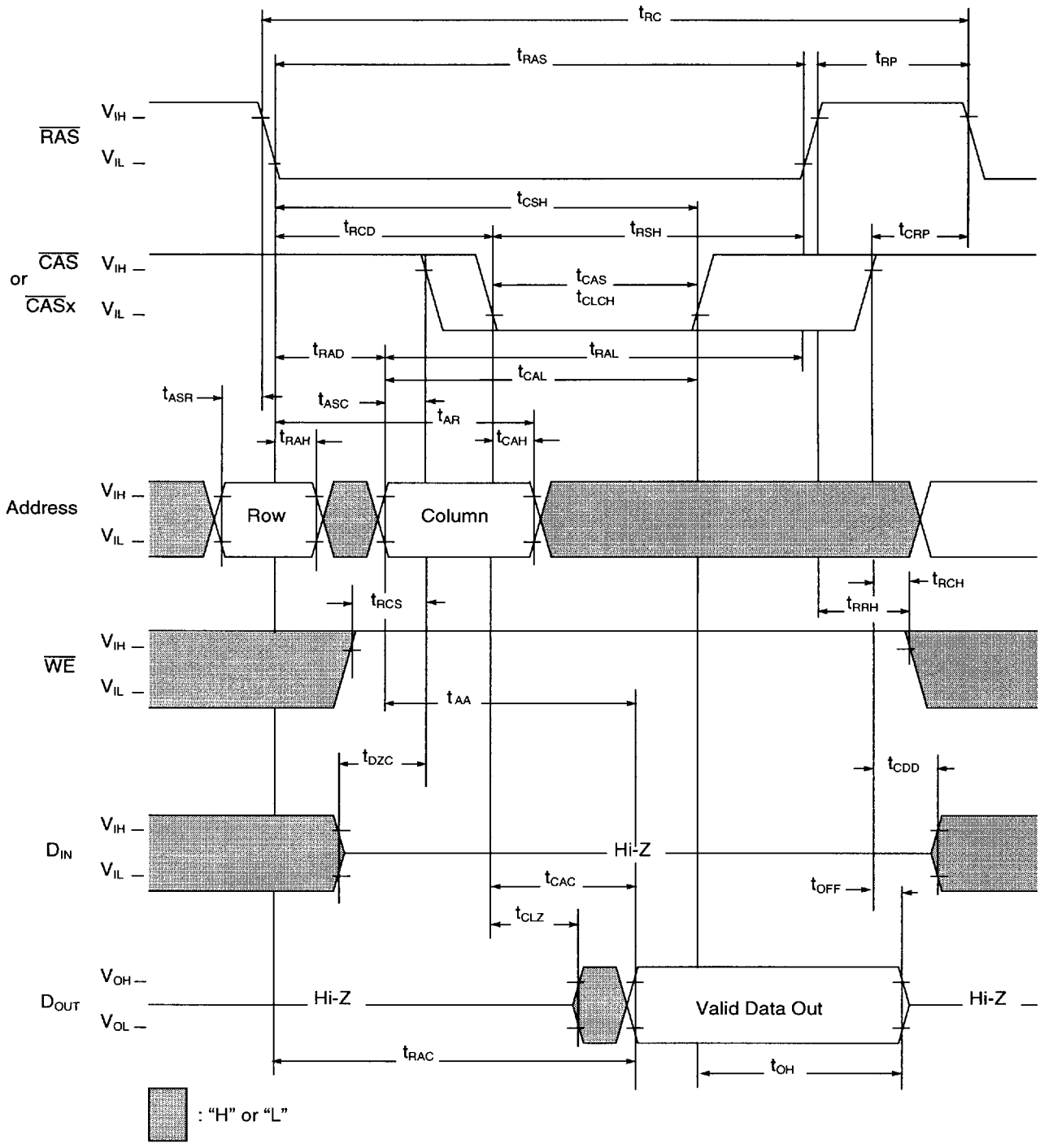
1. Access time is determined by the latter of t_{RAC}, t_{CAC}, t_{CPA}, t_{AA}.
2. Measured with the specified current load and 100pF.

Refresh Cycle

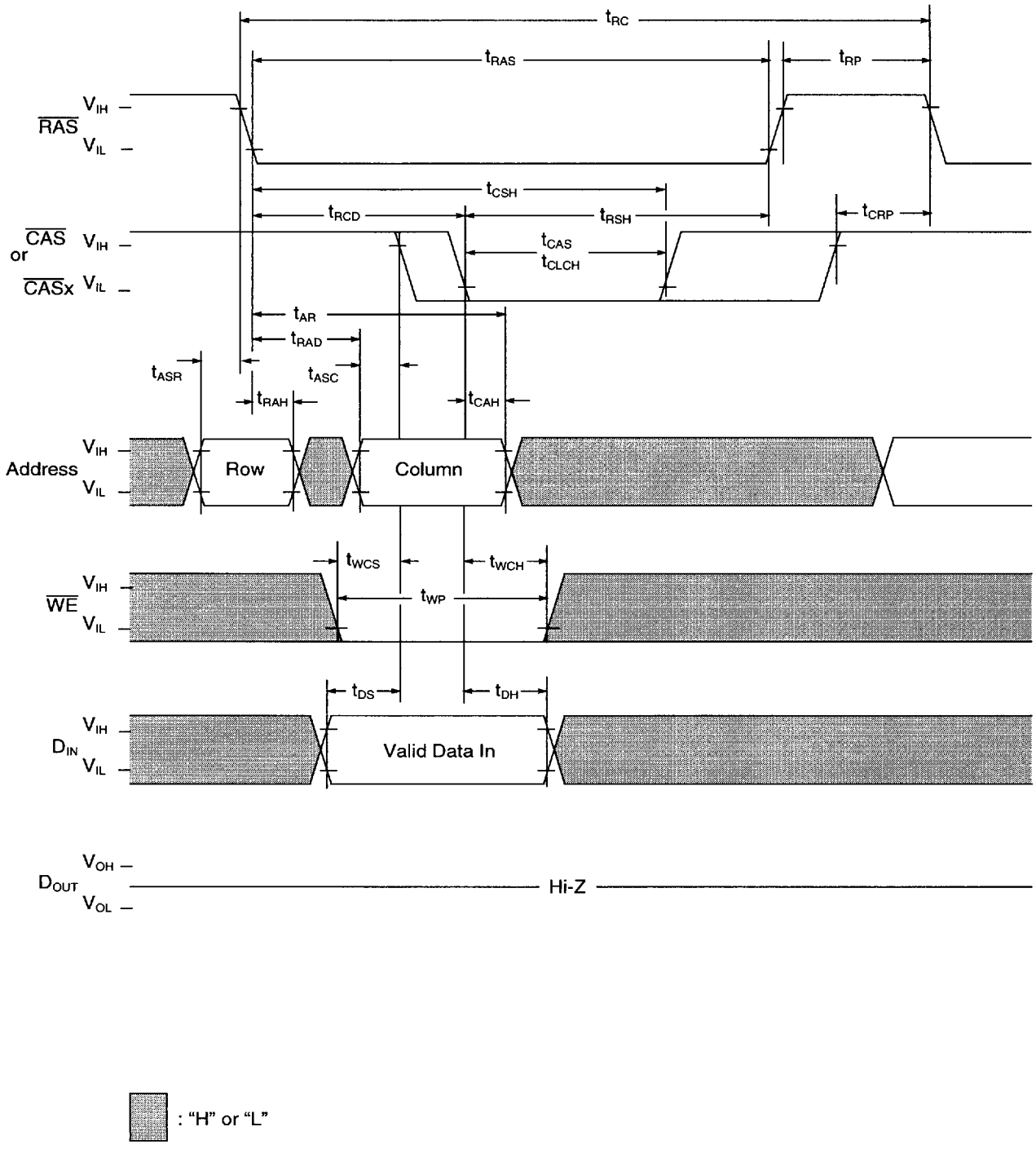
Symbol	Parameter	-60		-70		Units	Notes
		Min	Max	Min	Max		
t_{CHR}	$\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle)	10	—	10	—	ns	
t_{CSR}	$\overline{CAS}$ Setup Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle)	10	—	10	—	ns	
t_{WRP}	$\overline{WE}$ Setup Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle)	10	—	10	—	ns	
t_{WRH}	$\overline{WE}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle)	10	—	10	—	ns	
t_{RPC}	$\overline{RAS}$ Precharge to $\overline{CAS}$ Hold Time	0	—	0	—	ns	
t_{REF}	Refresh Period	—	16	—	16	ms	1

1. 1024 refreshes are required every 16ms.

Read Cycle

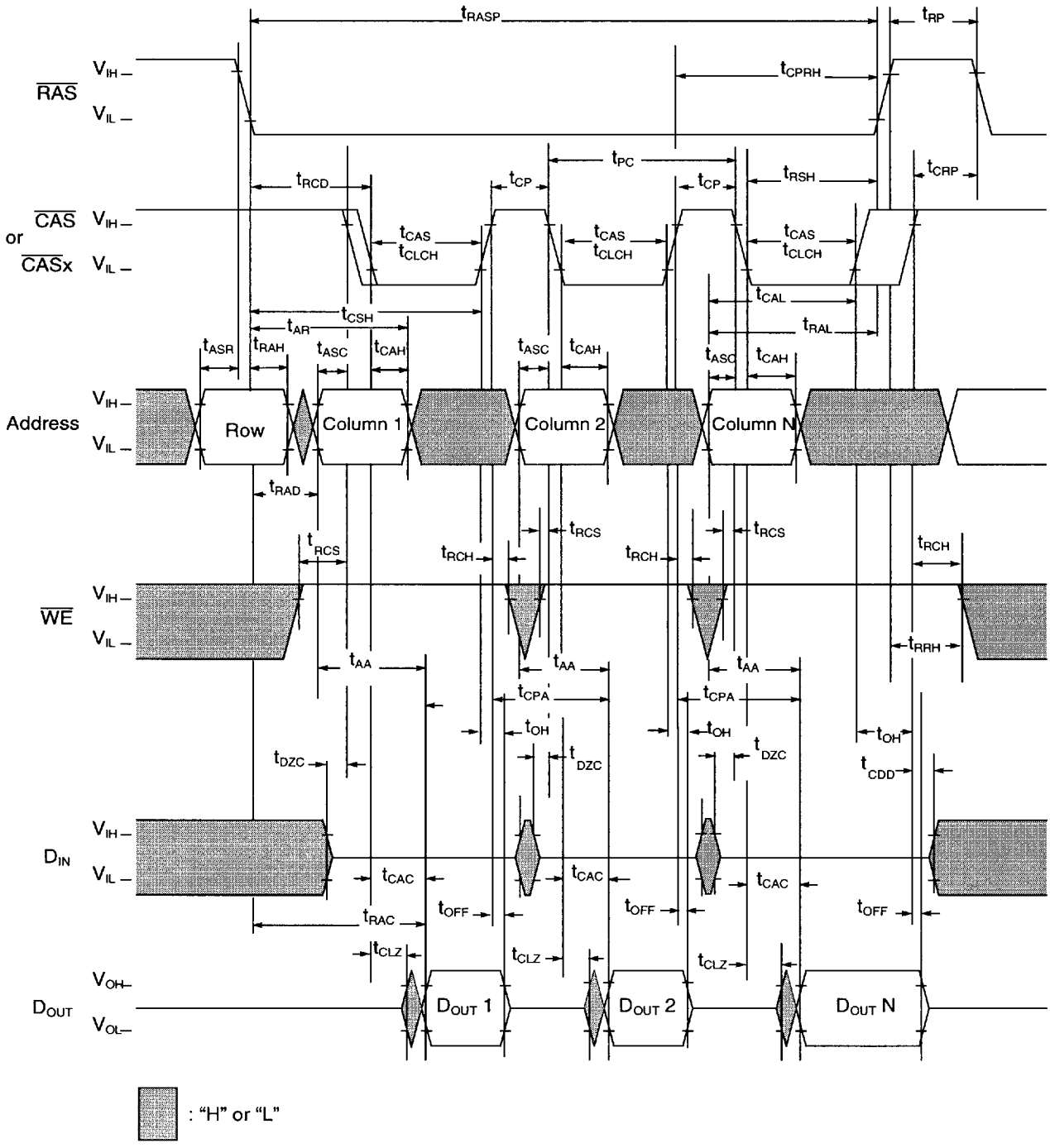


Write Cycle (Early Write)

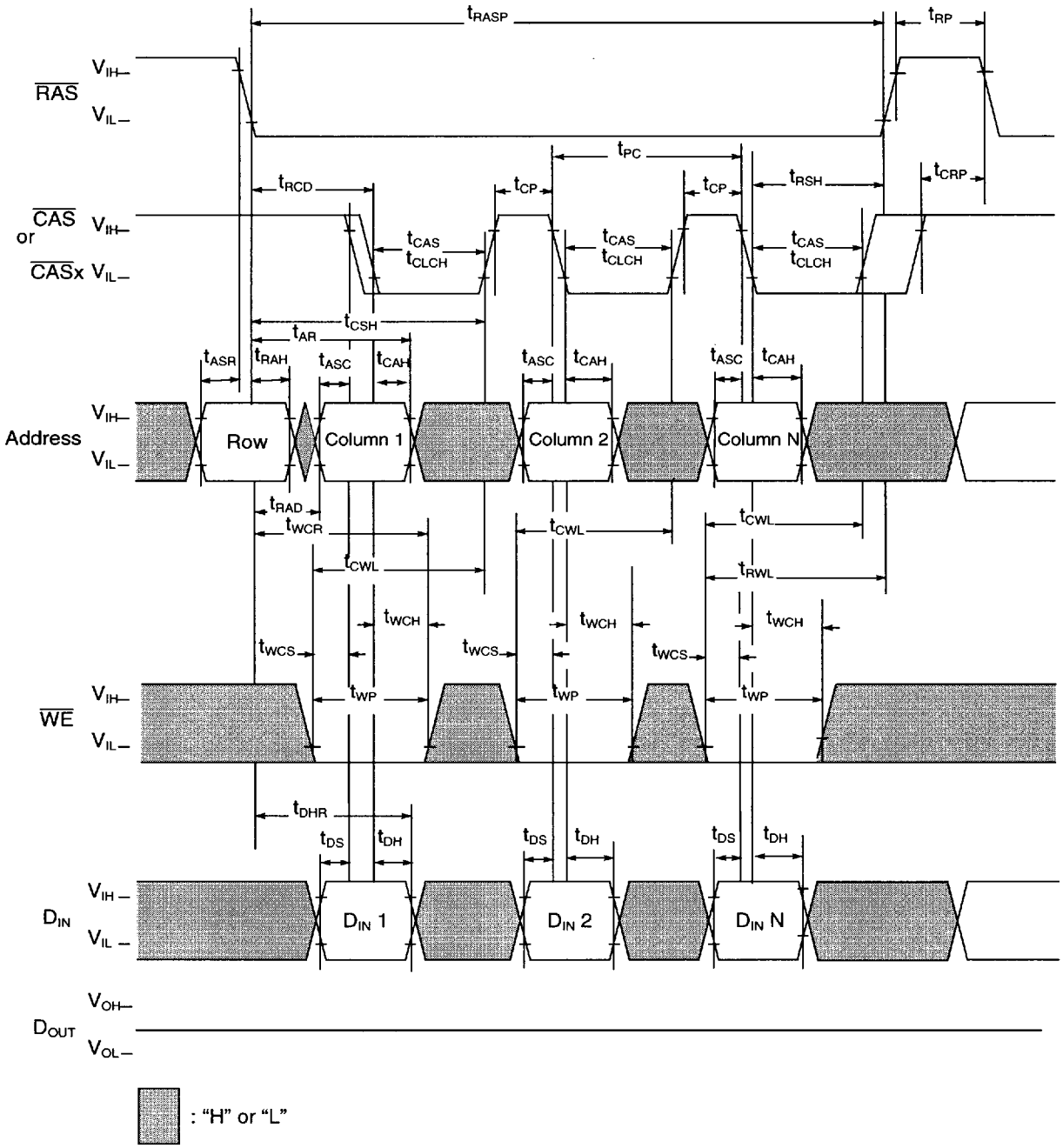


: "H" or "L"

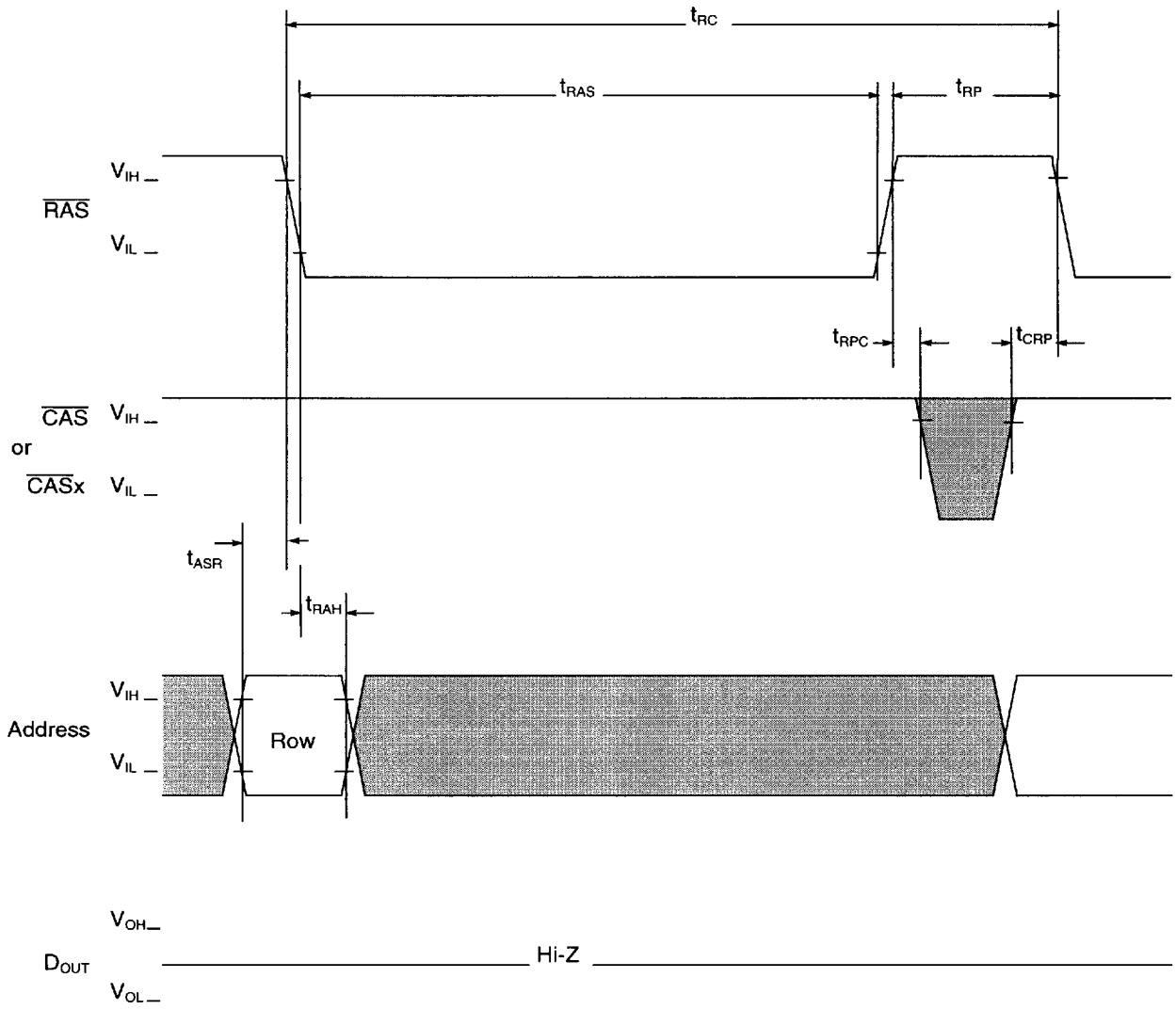
Fast Page Mode Read Cycle



Fast Page Mode Write Cycle



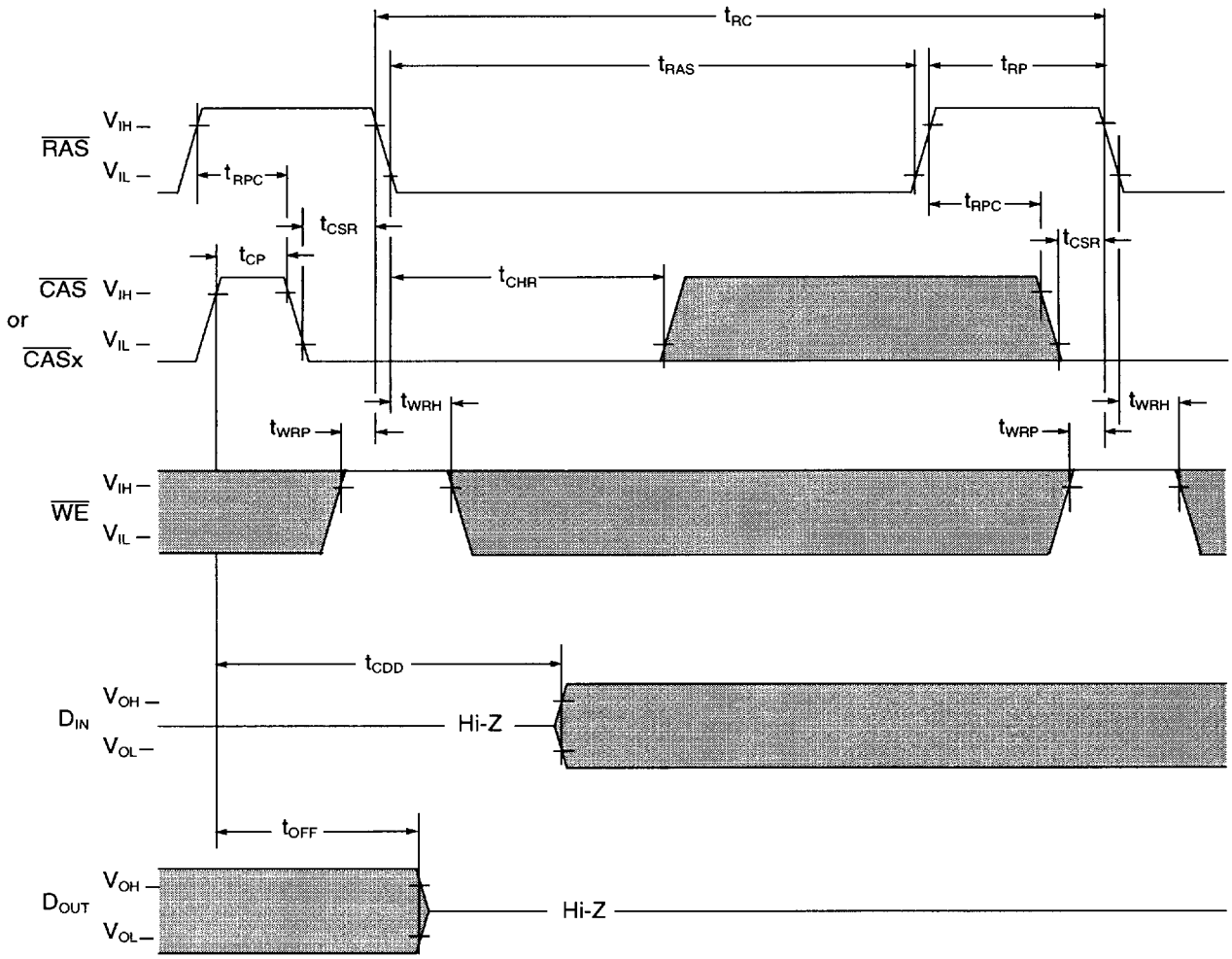
$\overline{RAS}$ Only Refresh Cycle



: "H" or "L"

Note: $\overline{WE}$, D_{IN} are "H" or "L"

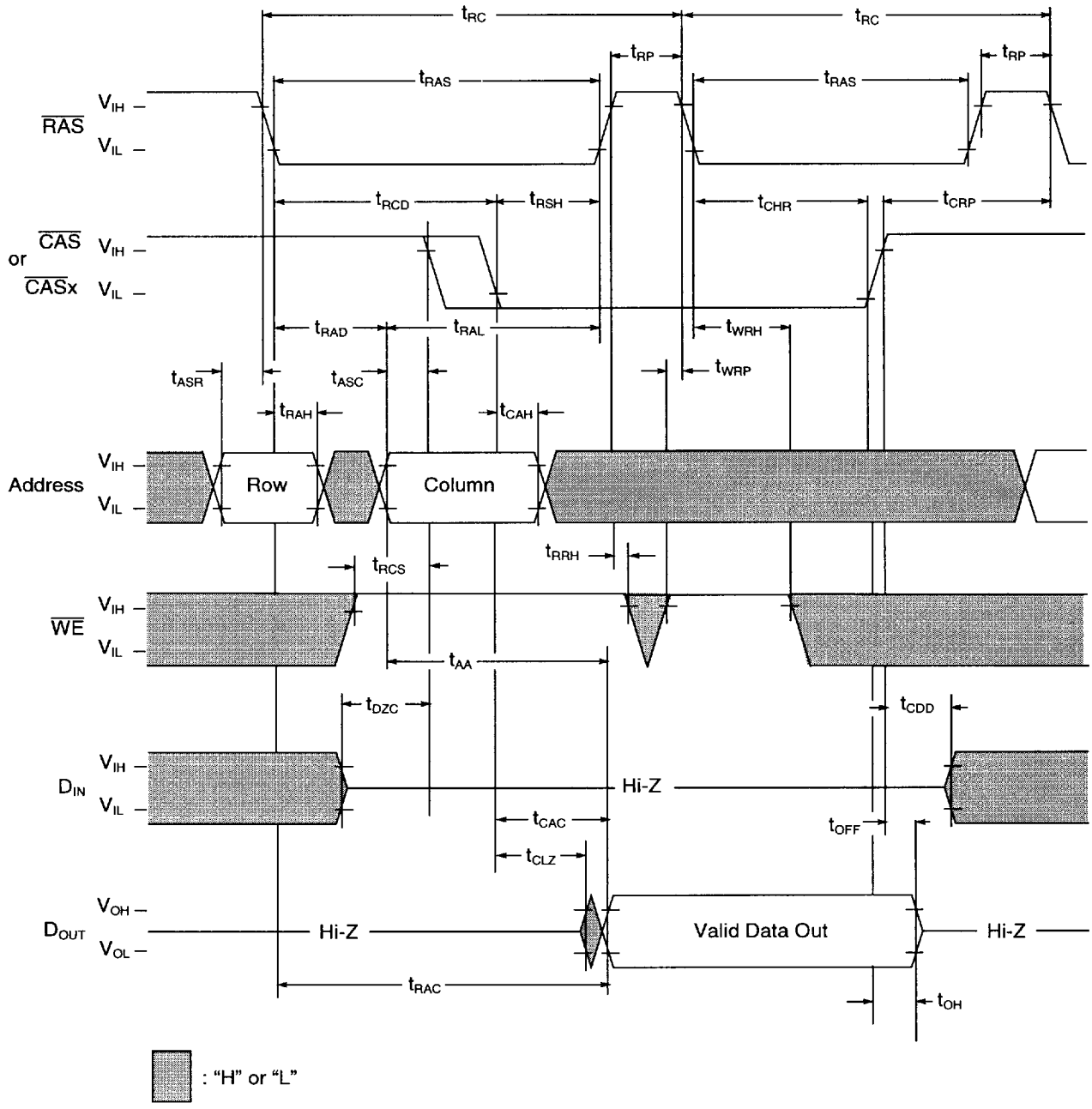
$\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$ Refresh Cycle



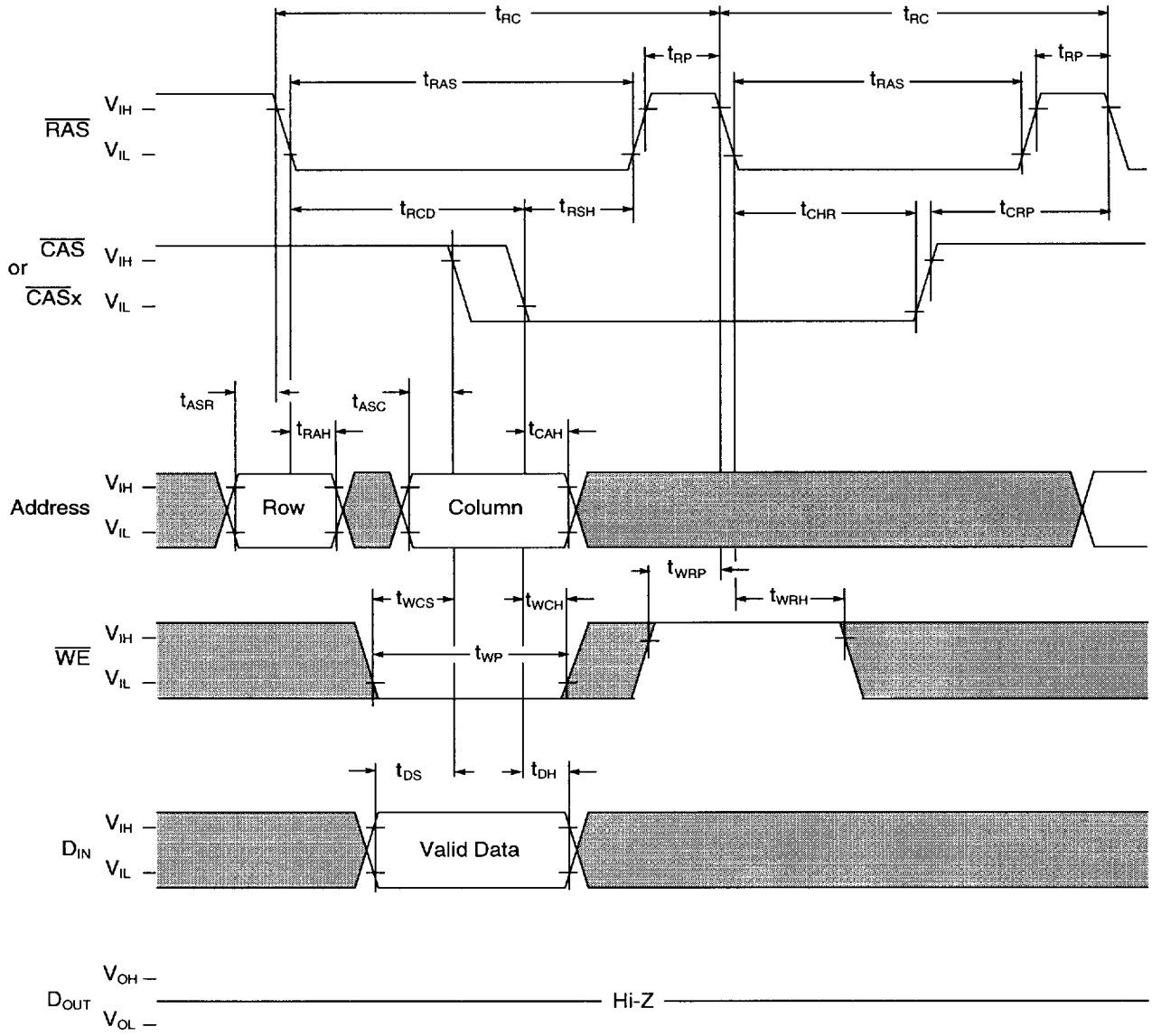
: "H" or "L"

NOTE: Address is "H" or "L"

Hidden Refresh Cycle (Read)

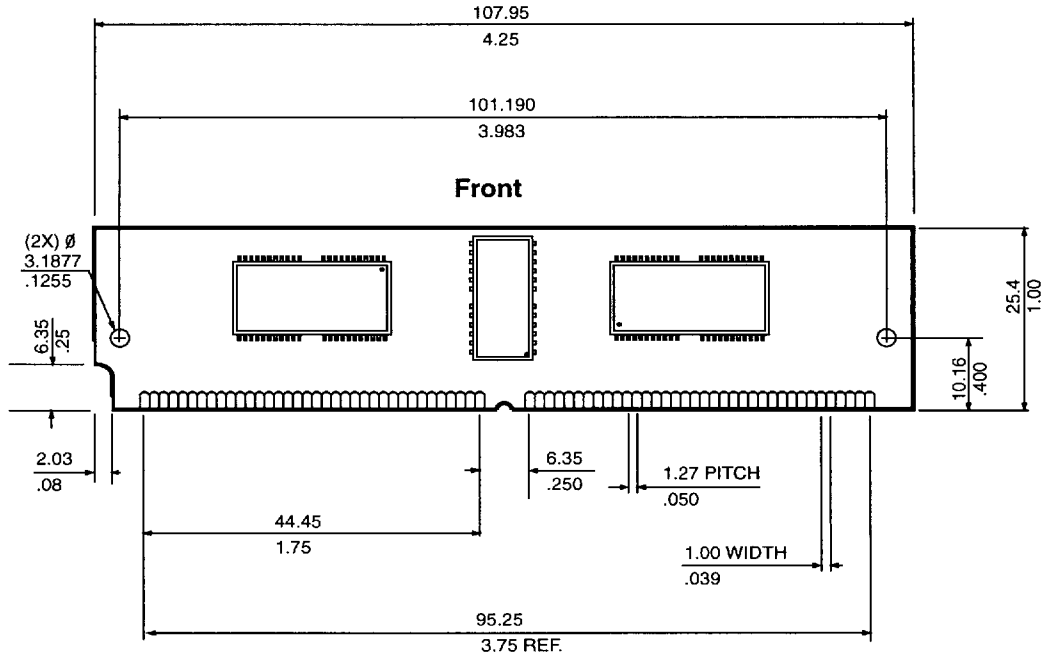


Hidden Refresh Cycle (Write)

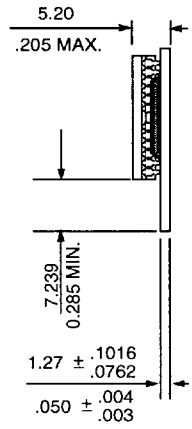


: "H" or "L"

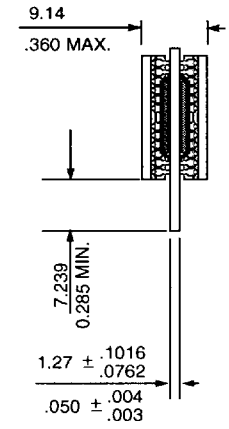
Layout Drawing: IBM11D/E1360Q (4MB) & IBM11D/E2360Q (8MB) (TSOP Version)



Side (4MB)

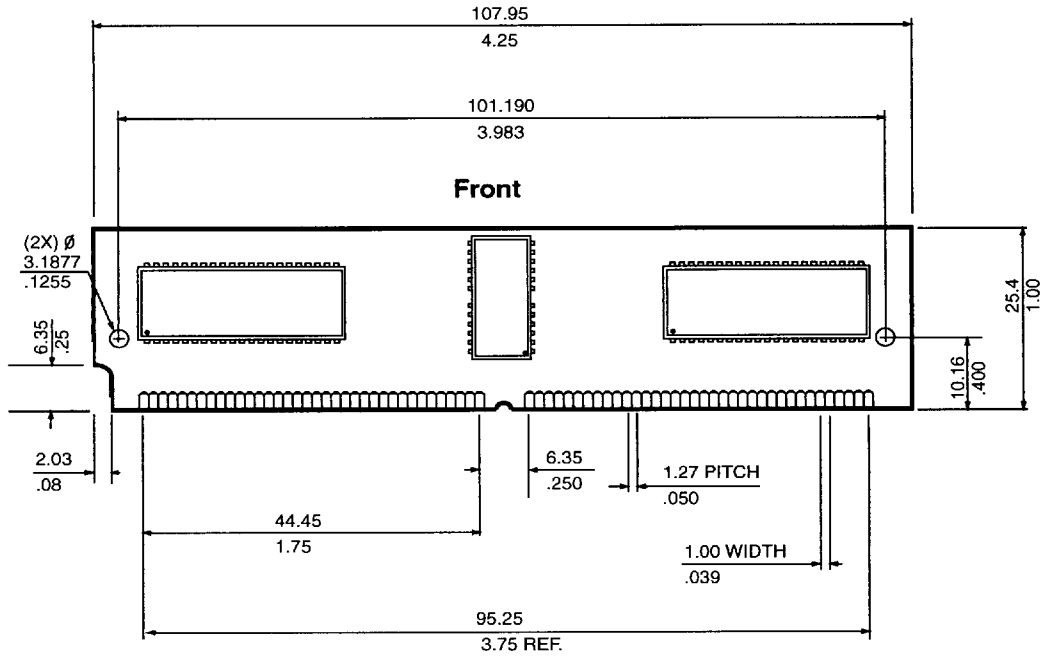


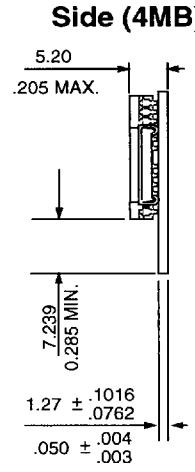
Side (8MB)

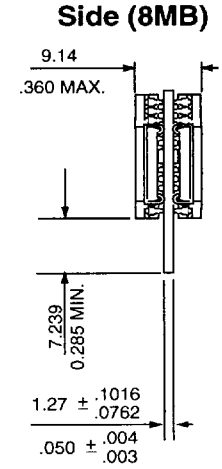


Note: All dimensions are typical unless otherwise stated. Millimeters / Inches

Layout Drawing: IBM11D/E1360Q (4MB) & IBM11D/E2360Q (8MB) SOJ Version







Note: All dimensions are typical unless otherwise stated. Millimeters / Inches

Revision Log

Rev	Contents of Modification
3/96	Initial release of combined spec for 1M x 36, 2M x 36 TSOP and SOJ versions. (originally released as spec #'s 26H2703 and 26H2704) Lowered operating currents and maximum power. Removed Die revision "C" offerings. CBR timing diagram changed to allow CAS to remain low for back-to-back CBR cycles
6/96	Added package description to speed designation Updated ordering information
8/96	Corrected typo's