V53C808H
HIGH PERFORMANCE
1M x 8 BIT EDO PAGE MODE
CMOS DYNAMIC RAM
OPTIONAL SELF REFRESH

PRELIMINARY

HIGH PERFORMANCE	35	40	45	50
Max. $\overline{RAS}$ Access Time, (t_{RAC})	35 ns	40 ns	45 ns	50 ns
Max. Column Address Access Time, (t_{CAA})	18 ns	20 ns	22 ns	24 ns
Min. Extended Data Out Mode Cycle Time, (t_{PC})	14 ns	15 ns	17 ns	19 ns
Min. Read/Write Cycle Time, (t_{RC})	70 ns	75 ns	80 ns	90 ns

Features

- 1M x 8-bit organization
- EDO Page Mode for a sustained data rate of 72 MHz
- $\overline{RAS}$ access time: 35, 40, 45, 50 ns
- Low power dissipation
- Read-Modify-Write, $\overline{RAS}$-Only Refresh, $\overline{CAS}$-Before-$\overline{RAS}$ Refresh capability
- Optional Self Refresh (V53C808SH)
- Refresh Interval: 1024 cycles/16 ms
- Available in 28-pin 400 mil SOJ package
- Single +5V ± 10% Power Supply
- TTL Interface

Description

The V53C808H is a ultra high speed 1,048,576 x 8 bit CMOS dynamic random access memory. The V53C808H offers a combination of features: Page Mode with Extended Data Output for high data bandwidth, and Low CMOS standby current.

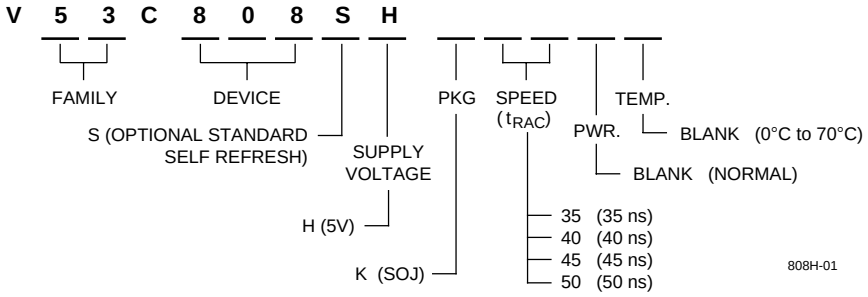
All inputs and outputs are TTL compatible. Input and output capacitances are significantly lowered to allow increased system performance. Page Mode with Extended Data Output operation allows random access of up to 1024 x 8 bits within a row with cycle times as fast as 14 ns.

The V53C808H is ideally suited for graphics, digital signal processing and high-performance computing systems.

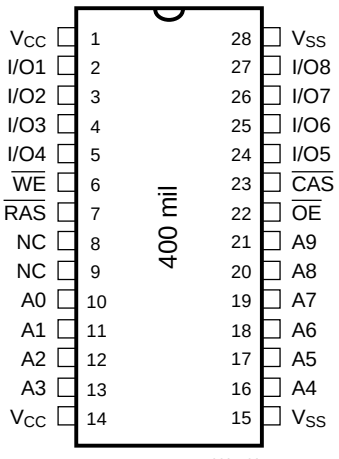
Device Usage Chart

Operating Temperature Range	Package Outline		Access Time (ns)				Power	Temperature Mark
	K	T	35	40	45	50	Std.	
0°C to 70 °C	•	•	•	•	•	•	•	Blank

Part Name	Self Refresh	Supply Voltage	Package	Speed
V53C808HKxx	No Self Refresh	5V	SOJ	35/40/45/50
V53C808HTxx	No Self Refresh	5V	TSOP	35/40/45/50
V53C808SHKxx	Optional Standard Self Refresh (16ms)	5V	SOJ	35/40/45/50
V53C808SHTxx	Optional Standard Self Refresh (16ms)	5V	TSOP	35/40/45/50



28-Pin Plastic SOJ PIN CONFIGURATION Top View



Pin Names

A_0–A_9	Address Inputs
$\overline{RAS}$	Row Address Strobe
$\overline{CAS}$	Column Address Strobe
$\overline{WE}$	Write Enable
$\overline{OE}$	Output Enable
I/O_1–I/O_8	Data Input, Output
V_{CC}	+5V Supply
V_{SS}	0V Supply
NC	No Connect

*Absolute Maximum Ratings**

Ambient Temperature
Under Bias ..... –10°C to +80°C
Storage Temperature (plastic) ..... –55°C to +125°C
Voltage Relative to V_{SS} .....–1.0 V to +7.0 V
Data Output Current ..... 50 mA
Power Dissipation ..... 1.4 W

***Note:** Operation above Absolute Maximum Ratings can adversely affect device reliability.

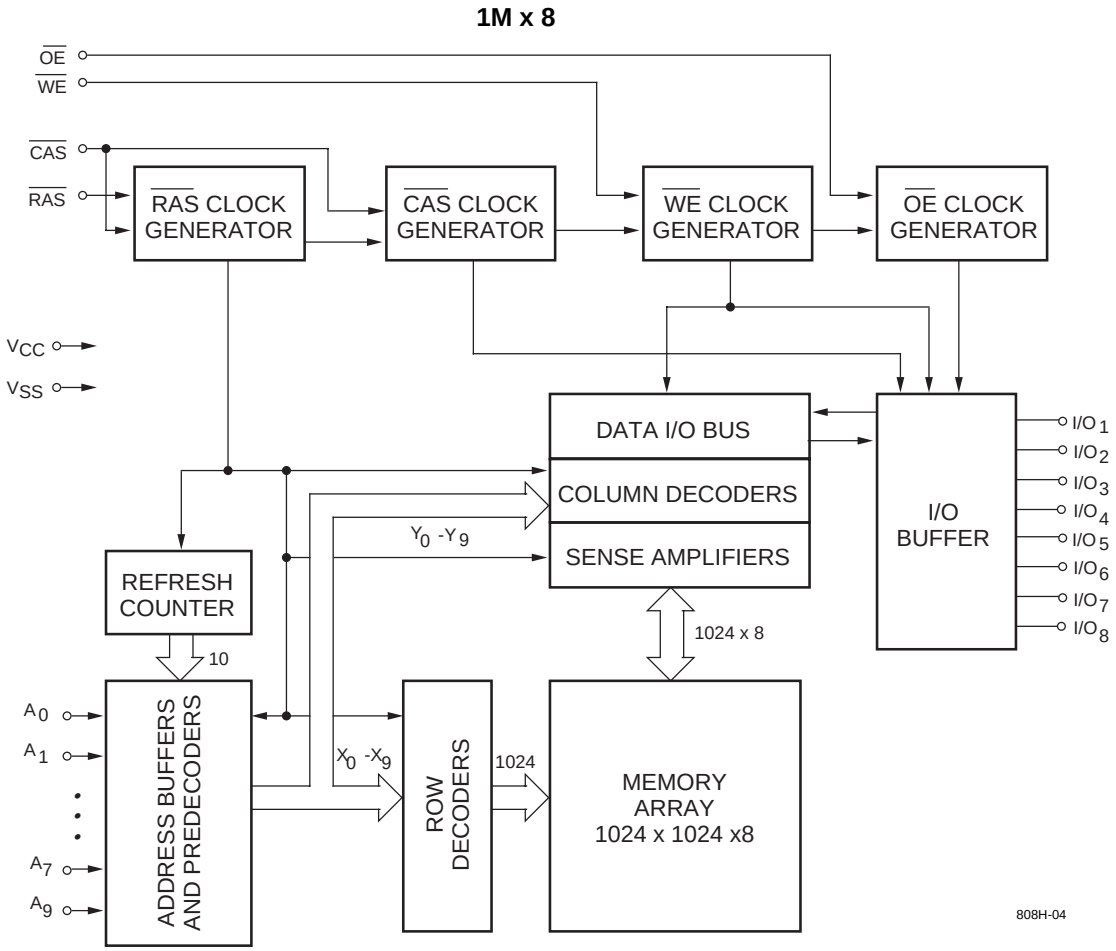
*Capacitance**

T_A = 25°C, V_{CC} = 5 V ± 10%, f = 1 MHz

Symbol	Parameter	Typ.	Max.	Unit
C_{IN1}	Address Input	3	4	pF
C_{IN2}	$\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$, $\overline{OE}$	4	5	pF
C_{OUT}	Data Input/Output	5	7	pF

*** Note:** Capacitance is sampled and not 100% tested

Block Diagram



DC and Operating Characteristics

T_A = 0°C to 70°C, V_{CC} = 5 V ± 10%, V_{SS} = 0 V, unless otherwise specified.

Symbol	Parameter	Access Time	V53C808H			Unit	Test Conditions	Notes
			Min.	Typ.	Max.			
I_{LI}	Input Leakage Current (any input pin)		–10		10	µA	$V_{SS} \le V_{IN} \le V_{CC}$	
I_{LO}	Output Leakage Current (for High-Z State)		–10		10	µA	$V_{SS} \le V_{OUT} \le V_{CC}$ $\overline{RAS}$, $\overline{CAS}$ at V_{IH}	
I_{CC1}	V_{CC} Supply Current, Operating	35			160	mA	$t_{RC} = t_{RC}$ (min.)	1, 2
		40			150			
		45			145			
		50			135			
I_{CC2}	V_{CC} Supply Current, TTL Standby				2	mA	$\overline{RAS}$, $\overline{CAS}$ at V_{IH} other inputs ≥ V_{SS}	
I_{CC3}	V_{CC} Supply Current, $\overline{RAS}$-Only Refresh	35			160	mA	$t_{RC} = t_{RC}$ (min.)	2
		40			150			
		45			145			
		50			135			
I_{CC4}	V_{CC} Supply Current, EDO Page Mode Operation	35			95	mA	Minimum cycle	1, 2
		40			90			
		45			85			
		50			80			
I_{CC5}	V_{CC} Supply Current, Standby, Output Enabled				2.0	mA	$\overline{RAS} = V_{IH}$, $\overline{CAS} = V_{IL}$ other inputs ≥ V_{SS}	1
I_{CC6}	V_{CC} Supply Current, CMOS Standby				2.0	mA	$\overline{RAS} \ge V_{CC} - 0.2$ V, $\overline{CAS} \ge V_{CC} - 0.2$ V, All other inputs ≥ V_{SS}	
I_{CC7}	Self Refresh Current				400	µA	CBR Cycle with $t_{RAS} \ge t_{RASS}$ (Min.) and $\overline{CAS} = V_{IL}$; WE = V_{CC}–0.2V; A0–A8 and $D_{IN} = V_{CC}$–0.2V	
V_{CC}	Supply Voltage		4.5	5.0	5.5	V		
V_{IL}	Input Low Voltage		–1		0.8	V		3
V_{IH}	Input High Voltage		2.4		V_{CC} + 1	V		3
V_{OL}	Output Low Voltage				0.4	V	I_{OL} = 2 mA	
V_{OH}	Output High Voltage		2.4			V	I_{OH} = –2 mA	

AC Characteristics

T_A = 0°C to 70°C, V_{CC} = 5 V ±10%, V_{SS} = 0V unless otherwise noted
AC Test conditions, input pulse levels 0 to 3V

			35		40		45		50			
#	Symbol	Parameter	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Unit	Notes
1	t_{RAS}	$\overline{RAS}$ Pulse Width	35	75K	40	75K	45	75K	50	75K	ns	
2	t_{RC}	Read or Write Cycle Time	70		75		80		90		ns	
3	t_{RP}	$\overline{RAS}$ Precharge Time	25		25		25		30		ns	
4	t_{CSH}	$\overline{CAS}$ Hold Time	35		40		45		50		ns	
5	t_{CAS}	$\overline{CAS}$ Pulse Width	7		8		9		9		ns	
6	t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay	16	23	17	28	18	32	19	36	ns	
7	t_{RCS}	Read Command Setup Time	0		0		0		0		ns	4
8	t_{ASR}	Row Address Setup Time	0		0		0		0		ns	
9	t_{RAH}	Row Address Hold Time	6		7		8		9		ns	
10	t_{ASC}	Column Address Setup Time	0		0		0		0		ns	
11	t_{CAH}	Column Address Hold Time	4		5		6		7		ns	
12	$t_{RSH\ (R)}$	$\overline{RAS}$ Hold Time (Read Cycle)	14		14		15		15		ns	
13	t_{CRP}	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5		5		5		5		ns	
14	t_{RCH}	Read Command Hold Time Referenced to $\overline{CAS}$	0		0		0		0		ns	5
15	t_{RRH}	Read Command Hold Time Referenced to $\overline{RAS}$	0		0		0		0		ns	5
16	t_{ROH}	$\overline{RAS}$ Hold Time Referenced to $\overline{OE}$	8		8		9		10		ns	
17	t_{OAC}	Access Time from $\overline{OE}$		12		12		13		14	ns	
18	t_{CAC}	Access Time from $\overline{CAS}$ (EDO)		12		12		13		14	ns	6, 7
19	t_{RAC}	Access Time from $\overline{RAS}$		35		40		45		50	ns	6, 8, 9
20	t_{CAA}	Access Time from Column Address		18		20		22		24	ns	6, 7, 10
21	t_{LZ}	$\overline{CAS}$ to Low-Z Output	0		0		0		0		ns	16
22	t_{HZ}	Output buffer turn-off delay time	0	6	0	6	0	7	0	8	ns	16
23	t_{AR}	Column Address Hold Time from $\overline{RAS}$	28		30		35		40		ns	
24	t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	11	17	12	20	13	23	14	26	ns	11
25	$t_{RSH\ (W)}$	$\overline{RAS}$ or $\overline{CAS}$ Hold Time in Write Cycle	12		12		13		14		ns	
26	t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	12		12		13		14		ns	
27	t_{WCS}	Write Command Setup Time	0		0		0		0		ns	12, 13
28	t_{WCH}	Write Command Hold Time	5		5		6		7		ns	
29	t_{WP}	Write Pulse Width	5		5		6		7		ns	
30	t_{WCR}	Write Command Hold Time from $\overline{RAS}$	28		30		35		40		ns	
31	t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	12		12		13		14		ns	

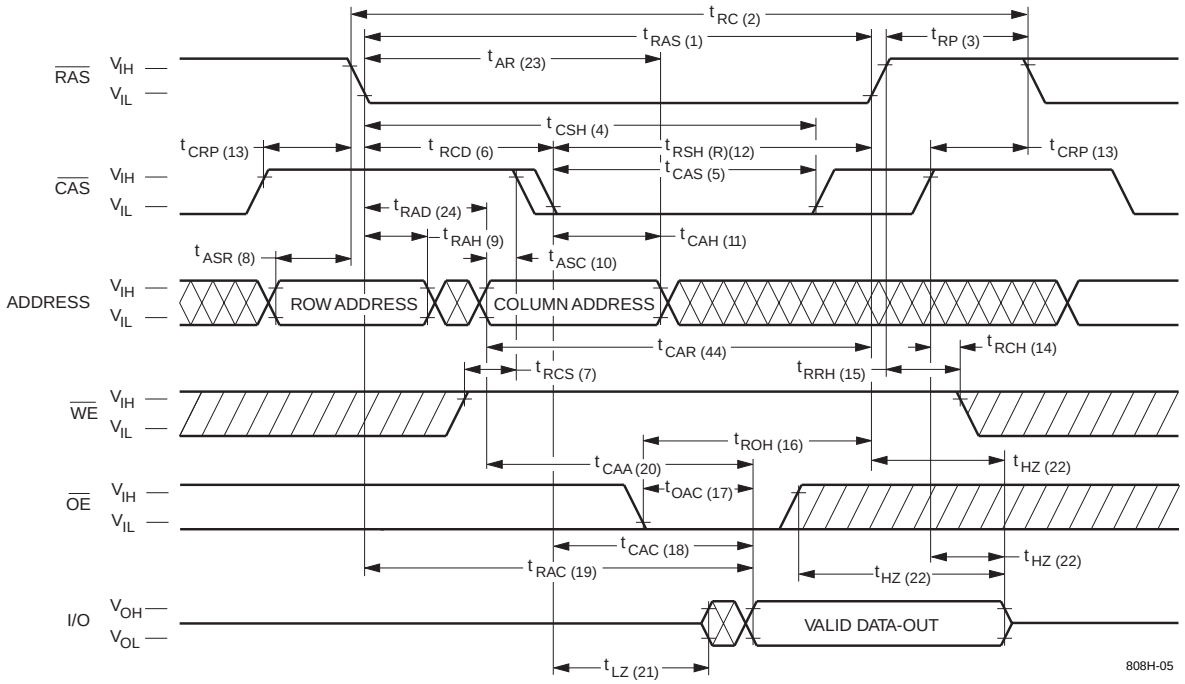
AC Characteristics (Cont'd)

#	Symbol	Parameter	35		40		45		50		Unit	Notes
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
32	t_{DS}	Data in Setup Time	0		0		0		0		ns	14
33	t_{DH}	Data in Hold Time	4		5		6		7		ns	14
34	t_{WOH}	Write to $\overline{OE}$ Hold Time	5		6		7		8		ns	14
35	t_{OED}	$\overline{OE}$ to Data Delay Time	5		6		7		8		ns	14
36	t_{RWC}	Read-Modify-Write Cycle Time	105		110		115		130		ns	
37	t_{RRW}	Read-Modify-Write Cycle $\overline{RAS}$ Pulse Width	70		75		80		87		ns	
38	t_{CWD}	$\overline{CAS}$ to $\overline{WE}$ Delay	28		30		32		34		ns	12
39	t_{RWD}	$\overline{RAS}$ to $\overline{WE}$ Delay in	54		58		62		68		ns	12
40	t_{CRW}	$\overline{CAS}$ Pulse Width (RMW)	46		48		50		52		ns	
41	t_{AWD}	Col. Address to $\overline{WE}$ Delay	35		38		41		42		ns	12
42	t_{PC}	EDO Page Mode Read or Write Cycle Time	14		15		17		19		ns	
43	t_{CP}	$\overline{CAS}$ Precharge Time	4		5		6		7		ns	
44	t_{CAR}	Column Address to $\overline{RAS}$ Setup Time	18		20		22		24		ns	
45	t_{CAP}	Access Time from Column Precharge		21		23		25		27	ns	7
46	t_{DHR}	Data in Hold Time Referenced to $\overline{RAS}$	28		30		35		40		ns	
47	t_{CSR}	$\overline{CAS}$ Setup Time $\overline{CAS}$-before-$\overline{RAS}$ Refresh	10		10		10		10		ns	
48	t_{RPC}	$\overline{RAS}$ to $\overline{CAS}$ Precharge Time	0		0		0		0		ns	
49	t_{CHR}	$\overline{CAS}$ Hold Time $\overline{CAS}$-before-$\overline{RAS}$ Refresh	8		8		10		12		ns	
50	t_{PCM}	EDO Page Mode Read-Modify-Write Cycle Time	58		60		65		70		ns	
51	t_T	Transition Time (Rise and Fall)	3	50	3	50	3	50	3	50	ns	15
52	t_{REF}	Refresh Interval (1024 Cycles)		16		16		16		16	ms	
53	t_{COH}	Output Hold After $\overline{CAS}$ Low		5		5		5		5	ns	
Optional Self Refresh												
54	t_{RASS}	$\overline{RAS}$ Pulse Width During Self Refresh	100		100		100		100		µs	18
55	t_{RPS}	$\overline{RAS}$ Precharge Time During Self Refresh	100		100		100		100		ns	18
56	t_{CHS}	$\overline{CAS}$ Hold Time Width During Self Refresh	100		100		100		100		ns	18
57	t_{CHD}	$\overline{CAS}$ Low Time During Self Refresh	100		100		100		100		µs	18

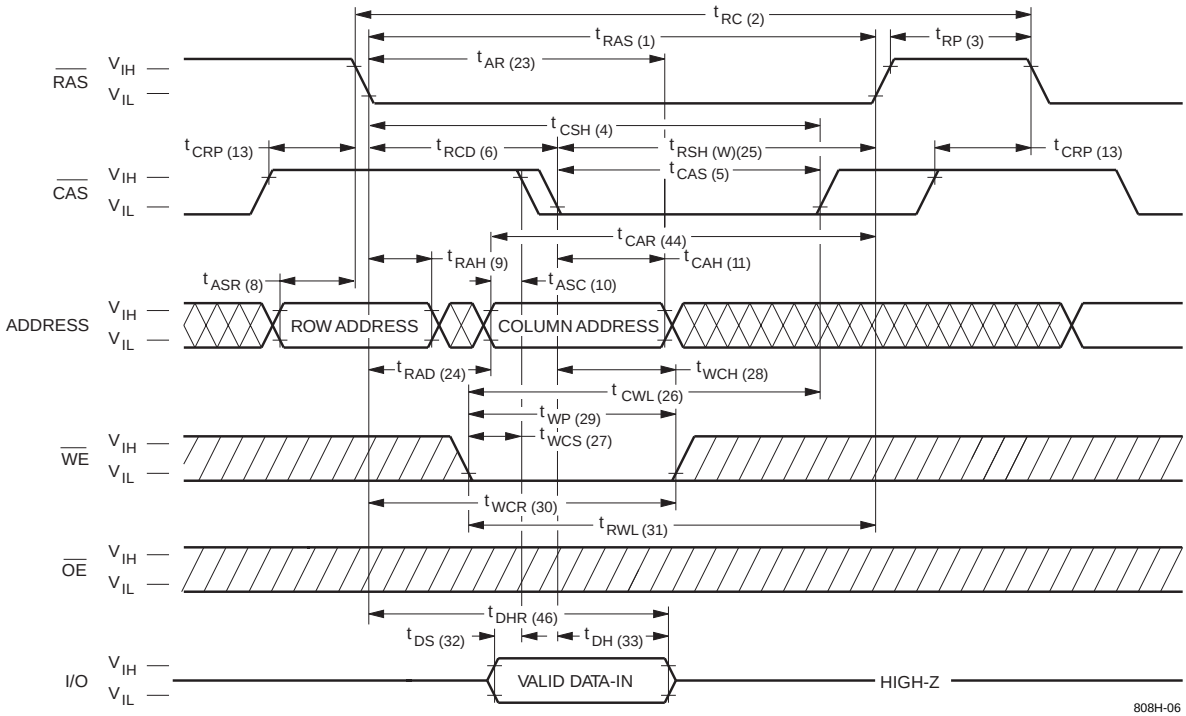
Notes:

1. I_{CC} is dependent on output loading when the device output is selected. Specified I_{CC} (max.) is measured with the output open.
2. I_{CC} is dependent upon the number of address transitions. Specified I_{DD} (max.) is measured with a maximum of two transitions per address cycle in EDO Page Mode.
3. Specified V_{IL} (min.) is steady state operating. During transitions, V_{IL} (min.) may undershoot to –1.0 V for a period not to exceed 20 ns. All AC parameters are measured with V_{IL} (min.) ≥ V_{SS} and V_{IH} (max.) ≤ V_{DD}.
4. t_{RCD} (max.) is specified for reference only. Operation within t_{RCD} (max.) limits insures that t_{RAC} (max.) and t_{CAA} (max.) can be met. If t_{RCD} is greater than the specified t_{RCD} (max.), the access time is controlled by t_{CAA} and t_{CAC}.
5. Either t_{RRH} or t_{RCH} must be satisified for a Read Cycle to occur.
6. Measured with a load equivalent to one TTL input and 50 pF.
7. Access time is determined by the longest of t_{CAA}, t_{CAC} and t_{CAP}.
8. Assumes that $t_{RAD} \leq t_{RAD}$ (max.). If t_{RAD} is greater than t_{RAD} (max.), t_{RAC} will increase by the amount that t_{RAD} exceeds t_{RAD} (max.).
9. Assumes that $t_{RCD} \leq t_{RCD}$ (max.). If t_{RCD} is greater than t_{RCD} (max.), t_{RAC} will increase by the amount that t_{RCD} exceeds t_{RCD} (max.).
10. Assumes that $t_{RAD} \geq t_{RAD}$ (max.).
11. 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, the access time is controlled by t_{CAA} and t_{CAC}.
12. t_{WCS}, t_{RWD}, t_{AWD} and t_{CWD} are not restrictive operating parameters.
13. t_{WCS} (min.) must be satisfied in an Early Write Cycle.
14. t_{DS} and t_{DH} are referenced to the latter occurrence of $\overline{CAS}$ or $\overline{WE}$.
15. t_T is measured between V_{IH} (min.) and V_{IL} (max.). AC-measurements assume t_T = 3 ns.
16. Assumes a three-state test load (5 pF and a 500 Ohm Thevenin equivalent).
17. An initial 200 μs pause and 8 $\overline{RAS}$-containing cycles are required when exiting an extended period of bias without clocks. An extended period of time without clocks is defined as one that exceeds the specified Refresh Interval.
18. Once CBR refresh or complete set of row refresh cycles must be completed upon exiting Self Refresh Mode.

Waveforms of Read Cycle

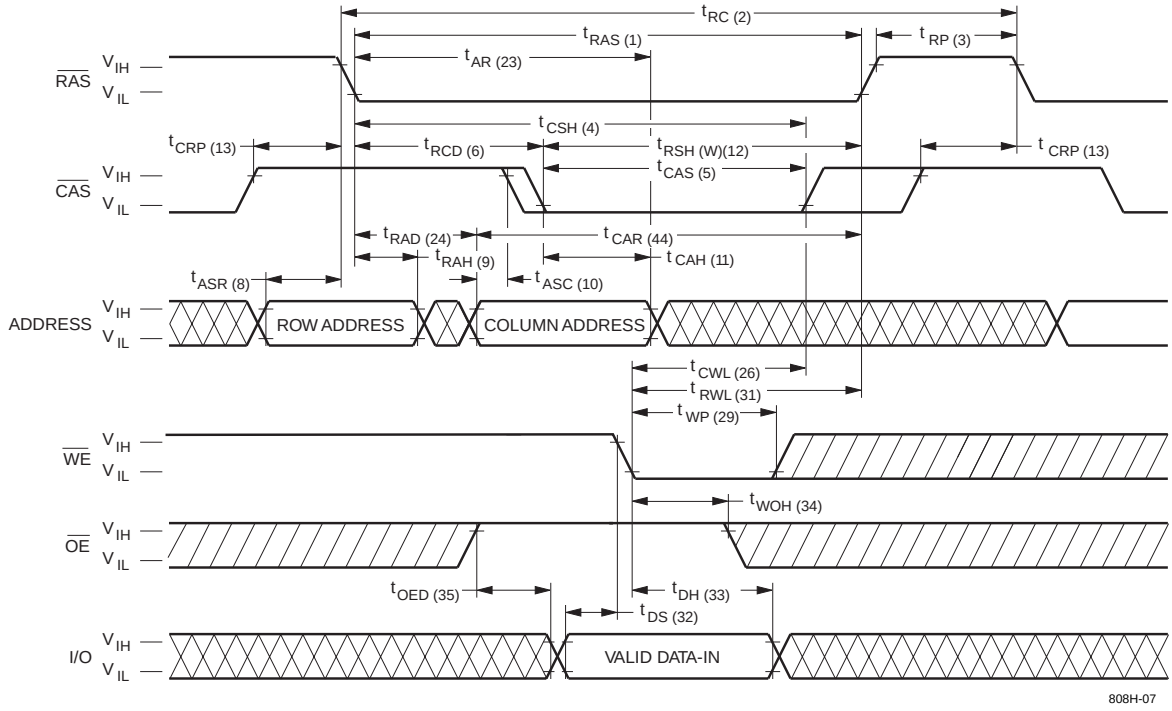


Waveforms of Early Write Cycle

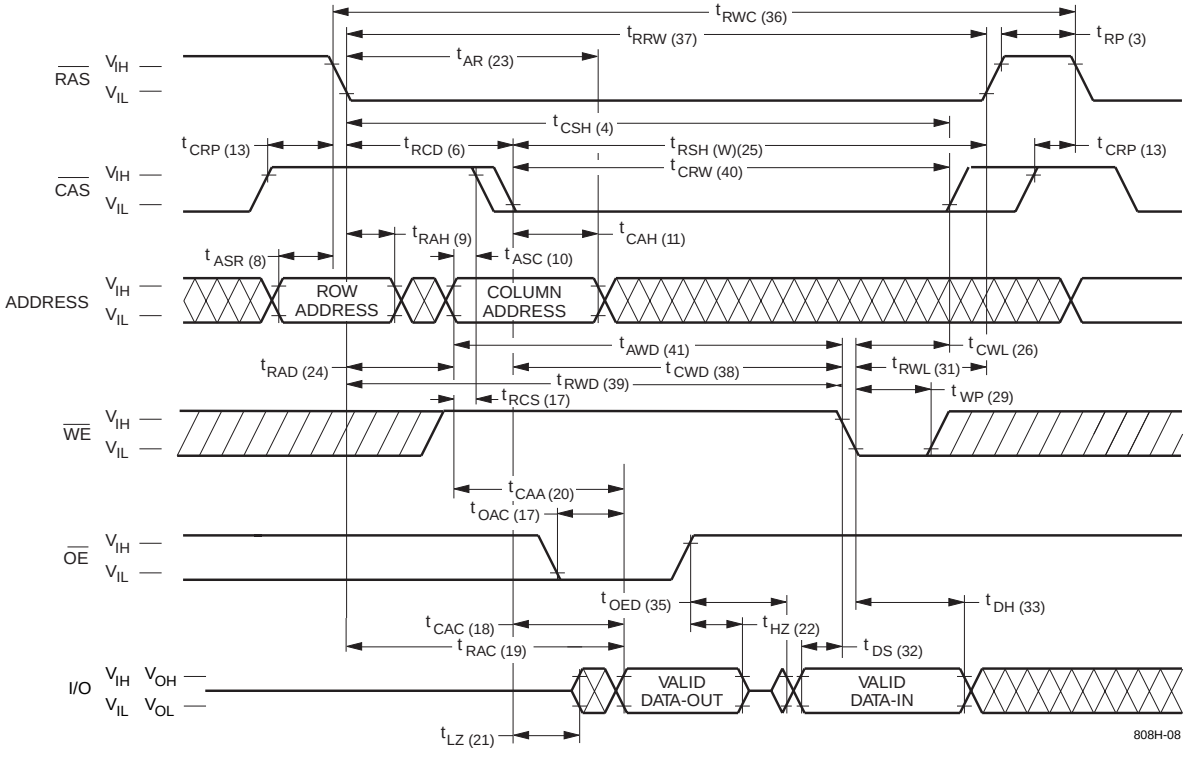


Don't Care Undefined

Waveforms of $\overline{OE}$-Controlled Write Cycle

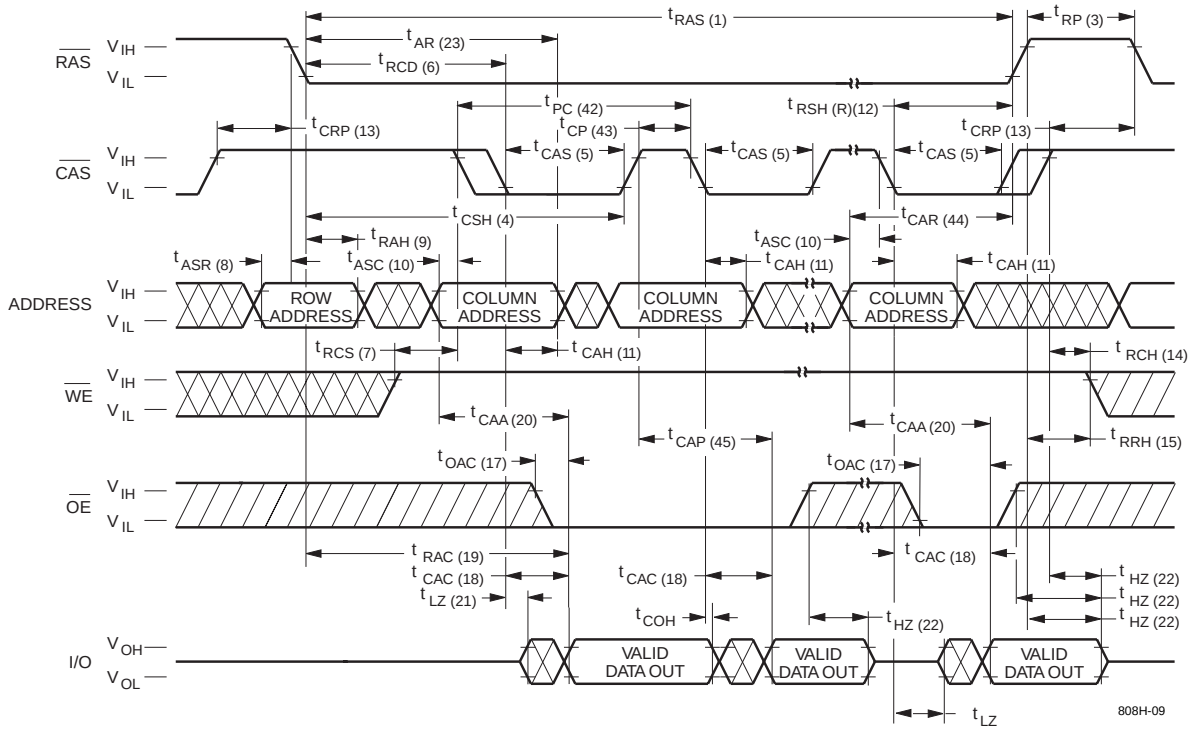


Waveforms of Read-Modify-Write Cycle

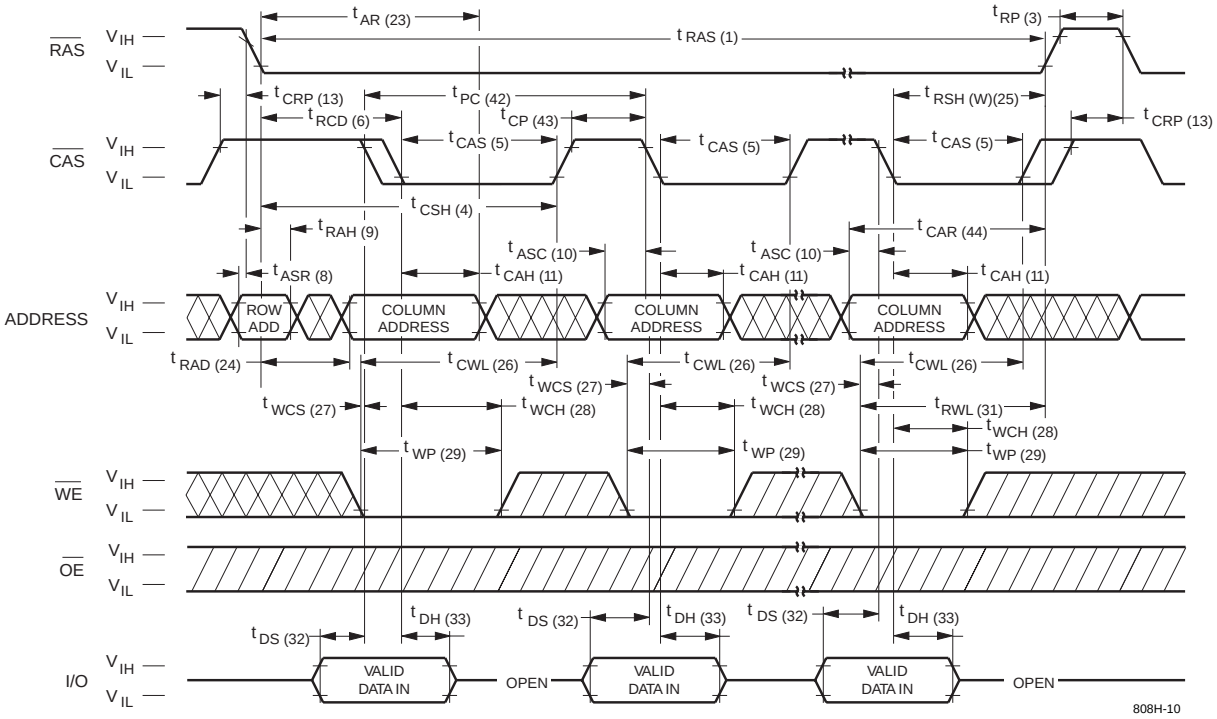


Don't Care Undefined

Waveforms of EDO Page Mode Read Cycle

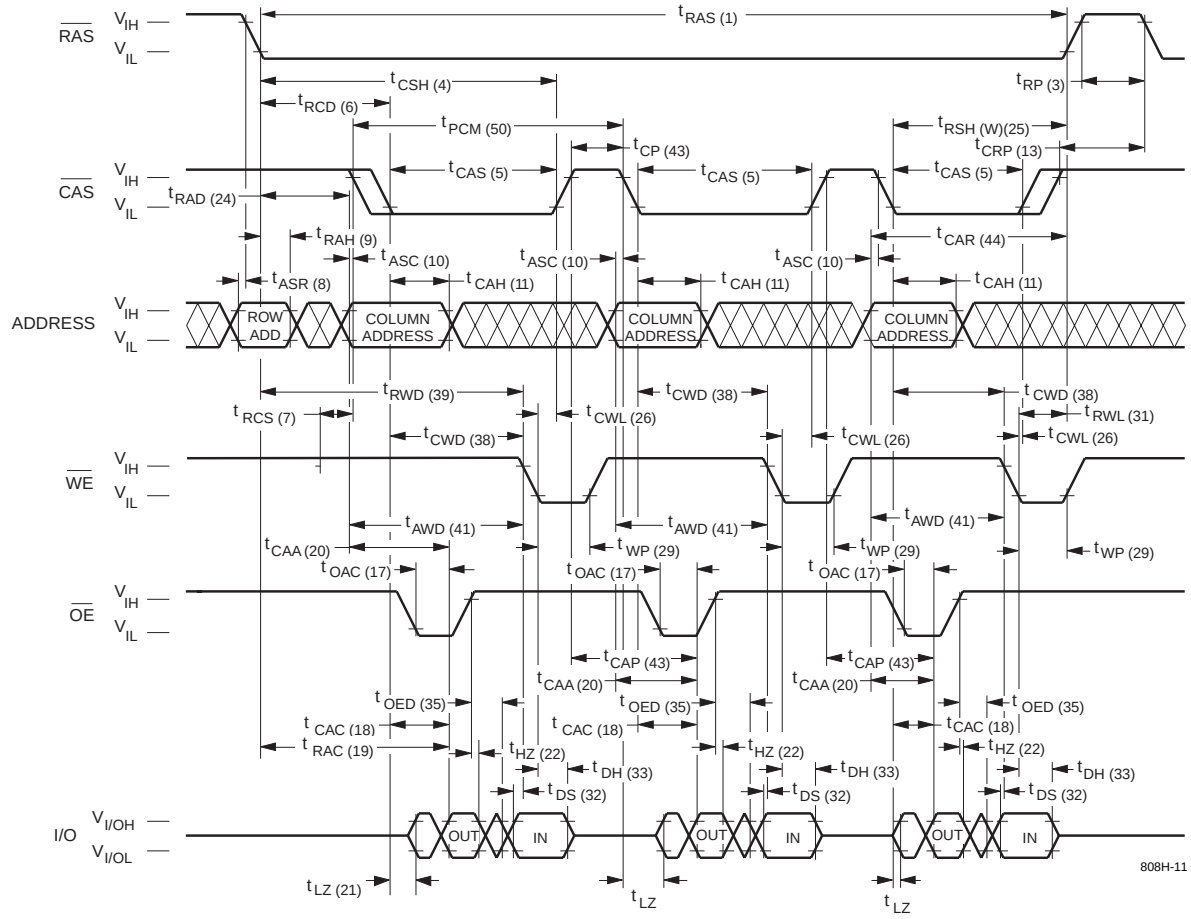


Waveforms of EDO Page Mode Write Cycle

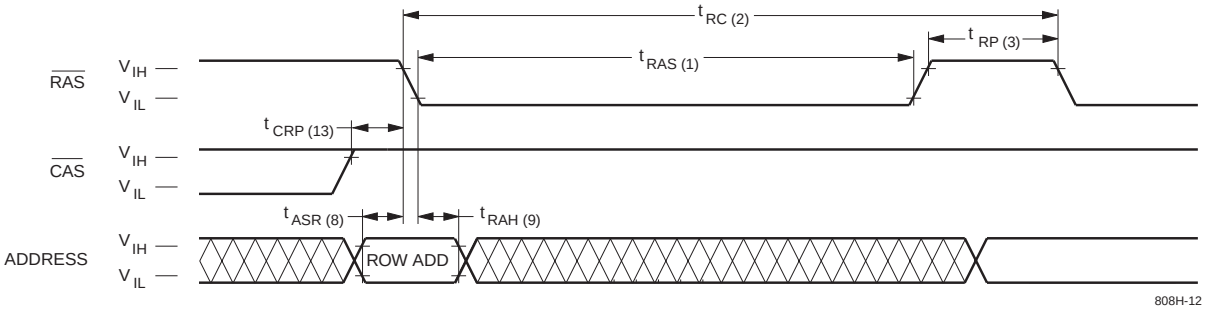


Don't Care Undefined

Waveforms of EDO Page Mode Read-Write Cycle



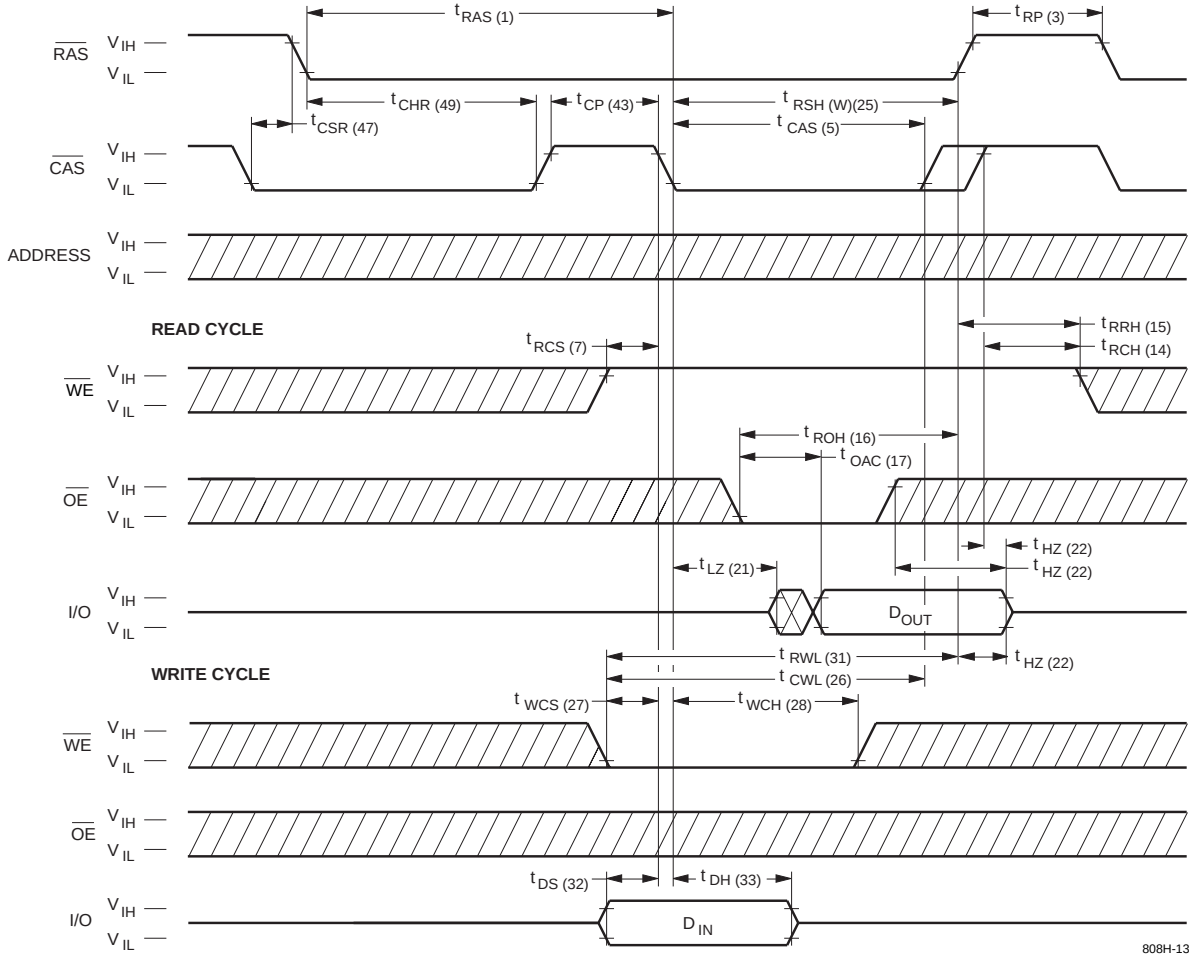
Waveforms of $\overline{RAS}$-Only Refresh Cycle



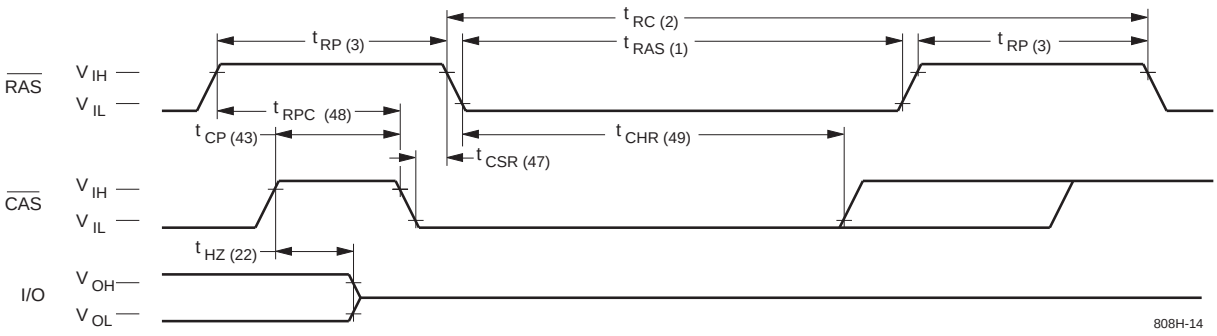
NOTE: $\overline{WE}$, $\overline{OE}$ = Don't care

Don't Care Undefined

Waveforms of $\overline{CAS}$-before-$\overline{RAS}$ Refresh Counter Test Cycle



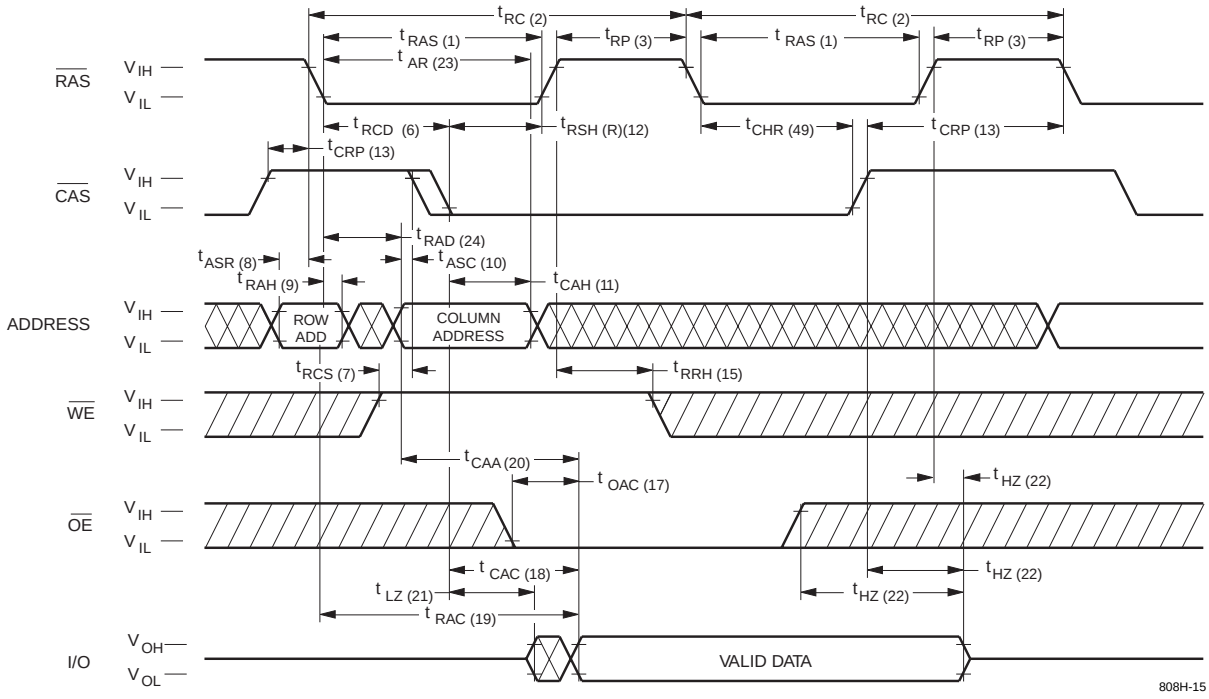
Waveforms of $\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle



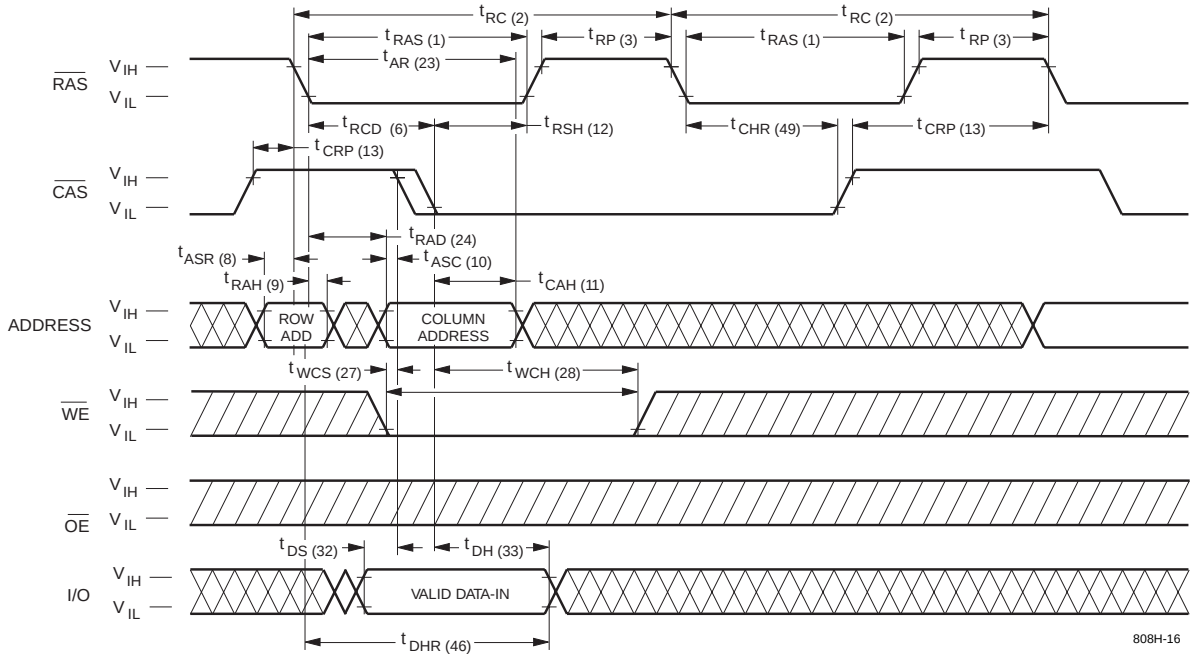
NOTE: $\overline{WE}$, $\overline{OE}$, A_0–A_9 = Don't care

Don't Care Undefined

Waveforms of Hidden Refresh Cycle (Read)

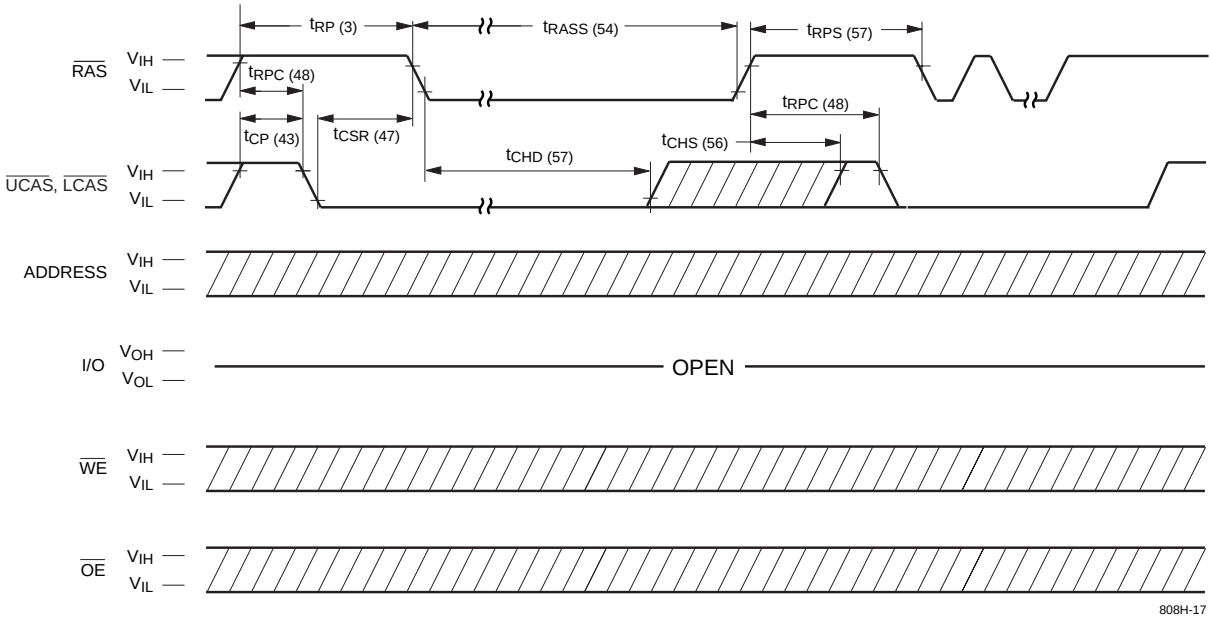


Waveforms of Hidden Refresh Cycle (Write)



Don't Care Undefined

Waveforms of Self Refresh Cycle (Optional)



Functional Description

The V53C808H is a CMOS dynamic RAM optimized for high data bandwidth, low power applications. It is functionally similar to a traditional dynamic RAM. The V53C808H reads and writes data by multiplexing an 20-bit address into a 10-bit row and a 10-bit column address. The row address is latched by the Row Address Strobe ($\overline{RAS}$). The column address "flows through" an internal address buffer and is latched by the Column Address Strobe ($\overline{CAS}$). Because access time is primarily dependent on a valid column address rather than the precise time that the $\overline{CAS}$ edge occurs, the delay time from $\overline{RAS}$ to $\overline{CAS}$ has little effect on the access time.

Memory Cycle

A memory cycle is initiated by bringing $\overline{RAS}$ low. Any memory cycle, once initiated, must not be ended or aborted before the minimum t_{RAS} time has expired. This ensures proper device operation and data integrity. A new cycle must not be initiated until the minimum precharge time t_{RP}/t_{CP} has elapsed.

Read Cycle

A Read cycle is performed by holding the Write Enable ($\overline{WE}$) signal High during a $\overline{RAS}/\overline{CAS}$ operation. The column address must be held for a minimum specified by t_{AR}. Data Out becomes valid only when t_{OAC}, t_{RAC}, t_{CAA} and t_{CAC} are all satisifed. As a result, the access time is dependent on the timing relationships between these parameters. For example, the access time is limited by t_{CAA} when t_{RAC}, t_{CAC} and t_{OAC} are all satisfied.

Write Cycle

A Write Cycle is performed by taking $\overline{WE}$ and $\overline{CAS}$ low during a $\overline{RAS}$ operation. The column address is latched by $\overline{CAS}$. The Write Cycle can be $\overline{WE}$ controlled or $\overline{CAS}$ controlled depending on whether $\overline{WE}$ or $\overline{CAS}$ falls later. Consequently, the input data must be valid at or before the falling edge of $\overline{WE}$ or $\overline{CAS}$, whichever occurs last. In the $\overline{CAS}$-controlled Write Cycle, when the leading edge of $\overline{WE}$ occurs prior to the $\overline{CAS}$ low transition, the I/O data pins will be in the High-Z state at the beginning of the Write function. Ending the Write with $\overline{RAS}$ or $\overline{CAS}$ will maintain the output in the High-Z state.

In the $\overline{WE}$ controlled Write Cycle, $\overline{OE}$ must be in the high state and t_{OED} must be satisfied.

Extended Data Output Page Mode

EDO Page operation permits all 1024 columns within a selected row of the device to be randomly accessed at a high data rate. Maintaining $\overline{RAS}$ low while performing successive $\overline{CAS}$ cycles retains the row address internally and eliminates the need to reapply it for each cycle. The column address buffer acts as a transparent or flow-through latch while $\overline{CAS}$ is high. Thus, access begins from the occurrence of a valid column address rather than from the falling edge of $\overline{CAS}$, eliminating t_{ASC} and t_T from the critical timing path. $\overline{CAS}$ latches the address into the column address buffer. During EDO operation, Read, Write, Read-Modify-Write or Read-Write-Read cycles are possible at random addresses within a row. Following the initial entry cycle into Hyper Page Mode, access is t_{CAA} or t_{CAP} controlled. If the column address is valid prior to the rising edge of $\overline{CAS}$, the access time is referenced to the $\overline{CAS}$ rising edge and is specified by t_{CAP}. If the column address is valid after the rising $\overline{CAS}$ edge, access is timed from the occurrence of a valid address and is specified by t_{CAA}. In both cases, the falling edge of $\overline{CAS}$ latches the address and enables the output.

EDO provides a sustained data rate of 72 MHz for applications that require high bandwidth such as bit-mapped graphics or high-speed signal processing. The following equation can be used to calculate the maximum data rate:

$$\text{Data Rate} = \frac{1024}{t_{RC} + 1023 \times t_{PC}}$$

Self Refresh (Optional)

Self Refresh mode provides internal refresh control signals to the DRAM during extended periods of inactivity. Device operation in this mode provides additional power savings and design ease by elimination of external refresh control signals. Self Refresh mode is initialed with a $\overline{CAS}$ before $\overline{RAS}$ (CBR) Refresh cycle, holding both $\overline{RAS}$ low (t_{RASS}) and $\overline{CAS}$ low (t_{CHD}) for a specified period. Both of these parameters are specified with minimum values to guarantee entry into Self Refresh operation. Once the device has been placed in to Self Refresh mode the $\overline{CAS}$ clock is no longer required to maintain Self Refresh operation.

The Self Refresh mode is terminated by returning the $\overline{RAS}$ clock to a high level for a specified (tRPS) minimum time. After termination of the Self Refresh cycle normal accesses to the device may be initiated immediately, poviding that subsequest refresh cycles utilize the $\overline{CAS}$ before $\overline{RAS}$ (CBR) mode of operation.

Data Output Operation

The V53C808H Input/Output is controlled by $\overline{OE}$, $\overline{CAS}$, $\overline{WE}$ and $\overline{RAS}$. A $\overline{RAS}$ low transition enables the transfer of data to and from the selected row address in the Memory Array. A $\overline{RAS}$ high transition disables data transfer and latches the output data if the output is enabled. After a memory cycle is initiated with a $\overline{RAS}$ low transition, a $\overline{CAS}$ low transition or $\overline{CAS}$ low level enables the internal I/O path. A $\overline{CAS}$ high transition or a $\overline{CAS}$ high level disables the I/O path and the output driver if it is enabled. A $\overline{CAS}$ low transition while $\overline{RAS}$ is high has no effect on the I/O data path or on the output drivers. The output drivers, when otherwise enabled, can be disabled by holding $\overline{OE}$ high. The $\overline{OE}$ signal has no effect on any data stored in the output latches. A $\overline{WE}$ low level can also disable the output drivers when $\overline{CAS}$ is low. During a Write cycle, if $\overline{WE}$ goes low at a time in relationship to $\overline{CAS}$ that would normally cause the outputs to be active, it is necessary to use $\overline{OE}$ to disable the output drivers prior to the $\overline{WE}$ low transition to allow Data In Setup Time (t_{DS}) to be satisfied.

Power-On

After application of the V_{CC} supply, an initial pause of 200 μs is required followed by a minimum of 8 initialization cycles (any combination of cycles containing a $\overline{RAS}$ clock). Eight initialization cycles are required after extended periods of bias without clocks (greater than the Refresh Interval).

During Power-On, the V_{CC} current requirement of the V53C808H is dependent on the input levels of $\overline{RAS}$ and $\overline{CAS}$. If $\overline{RAS}$ is low during Power-On, the device will go into an active cycle and I_{CC} will exhibit current transients. It is recommended that $\overline{RAS}$ and $\overline{CAS}$ track with V_{CC} or be held at a valid V_{IH} during Power-On to avoid current surges.

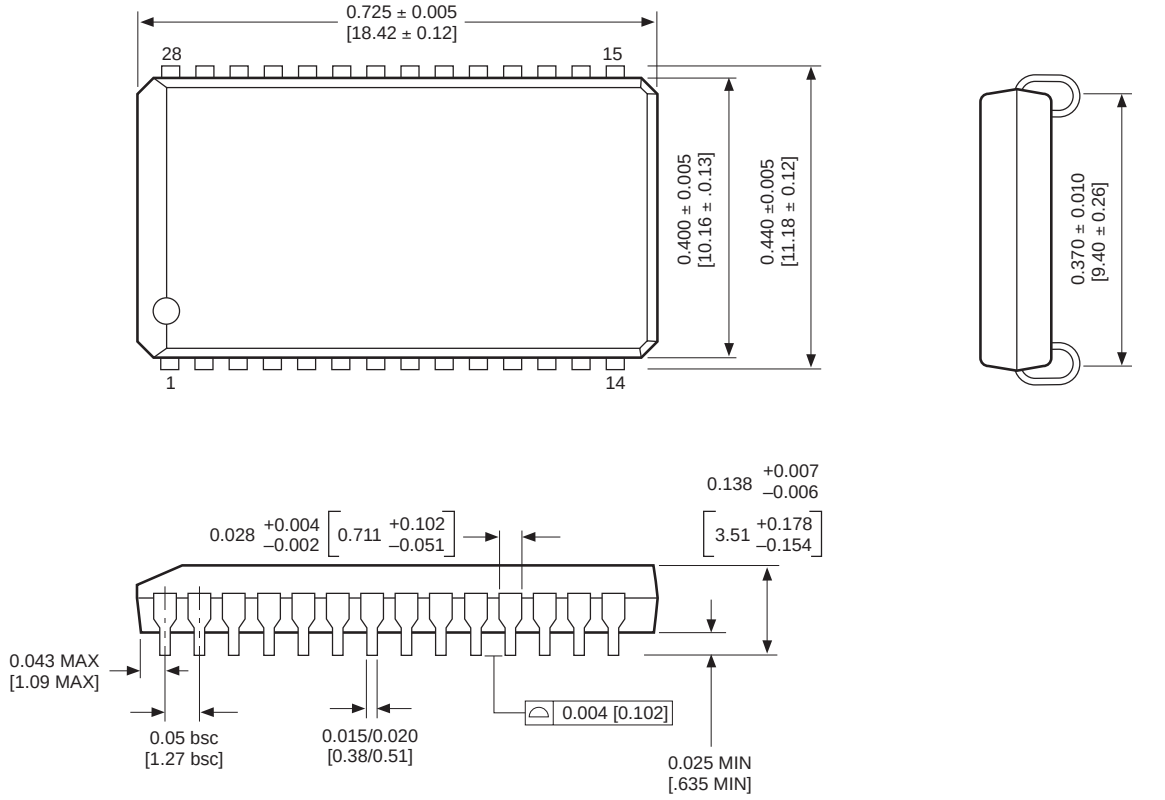
Table 1. V53C808H Data Output
Operation for Various Cycle Types

Cycle Type	I/O State
Read Cycles	Data from Addressed Memory Cell
$\overline{CAS}$-Controlled Write Cycle (Early Write)	High-Z
$\overline{WE}$-Controlled Write Cycle (Late Write)	$\overline{OE}$ Controlled. High $\overline{OE}$ = High-Z I/Os
Read-Modify-Write Cycles	Data from Addressed Memory Cell
EDO Read Cycle	Data from Addressed Memory Cell
EDO Write Cycle (Early Write)	High-Z
EDO Read-Modify-Write Cycle	Data from Addressed Memory Cell
$\overline{RAS}$-only Refresh	High-Z
$\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle	Data remains as in previous cycle
$\overline{CAS}$-only Cycles	High-Z

Package Diagrams

28-Pin Plastic SOJ

Unit in inches [mm]



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