

<b>HIGH PERFORMANCE</b>	<b>40</b>	<b>50</b>
Max. $\overline{\text{RAS}}$ Access Time, ( $t_{\text{RAC}}$ )	40 ns	50 ns
Max. Column Address Access Time, ( $t_{\text{CAA}}$ )	20 ns	24 ns
Min. Fast Page Mode Cycle Time, ( $t_{\text{PC}}$ )	23 ns	28 ns
Min. Read/Write Cycle Time, ( $t_{\text{RC}}$ )	75 ns	90 ns

**Features**

- 256K x 16-bit organization
- Fast Page Mode for a sustained data rate of 43 MHz
- $\overline{\text{RAS}}$  access time: 40, 50 ns
- Dual  $\overline{\text{CAS}}$  Inputs
- Low power dissipation
- Read-Modify-Write,  $\overline{\text{RAS}}$ -Only Refresh,  $\overline{\text{CAS}}$ -Before- $\overline{\text{RAS}}$  Refresh, and Self Refresh
- Refresh Interval: 512 cycles/8 ms
- Available in 40-pin 400 mil SOJ and 40/44L-pin 400 mil TSOP-II packages
- Single 5.0V  $\pm$ 10% Power Supply
- TTL Interface
- Self Refresh: 512 cycles/8ms

**Description**

The V53C16256SH is a 262,144 x 16 bit high-performance CMOS dynamic random access memory. The V53C16256SH offers Fast Page mode with dual  $\overline{\text{CAS}}$  inputs. An address,  $\overline{\text{CAS}}$  and  $\overline{\text{RAS}}$  input capacitances are reduced to one quarter when the x4 DRAM is used to construct the same memory density. The V53C16256SH has symmetric address and accepts 512 cycle 8ms interval.

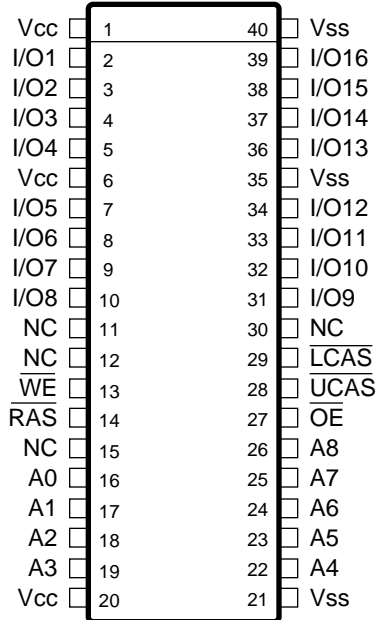
All inputs are TTL compatible. Fast Page Mode operation allows random access up to 512 x 16 bits, within a page, with cycle times as short as 23ns.

The V53C16256SH is best suited for graphics, and DSP applications.

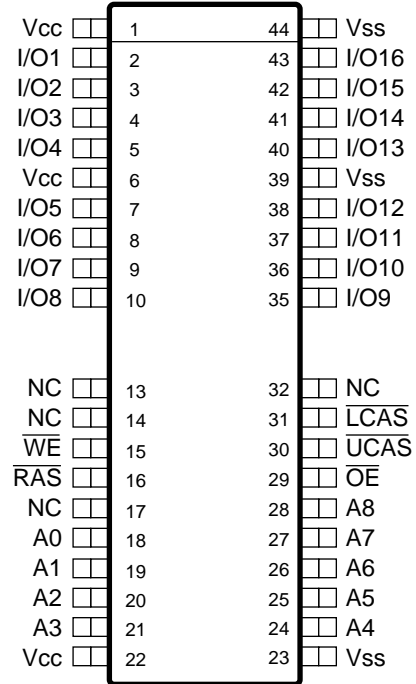
**Device Usage Chart**

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

**40-Pin Plastic SOJ  
PIN CONFIGURATION  
Top View**



**40/44 Pin Plastic TSOP-II  
PIN CONFIGURATION  
Top View**



**Pin Names**

A <sub>0</sub> -A <sub>8</sub>	Address Inputs
RAS	Row Address Strobe
UCAS	Column Address Strobe Upper Byte Control
LCAS	Column Address Strobe Lower Byte Control
WE	Write Enable
OE	Output Enable
I/O <sub>1</sub> -I/O <sub>16</sub>	Data Input, Output
V <sub>CC</sub>	+3.3V Supply
V <sub>SS</sub>	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<sub>SS</sub> ..... -1.0 V to +7.0 V  
 Data Output Current ..... 50 mA  
 Power Dissipation ..... 1.0 W

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

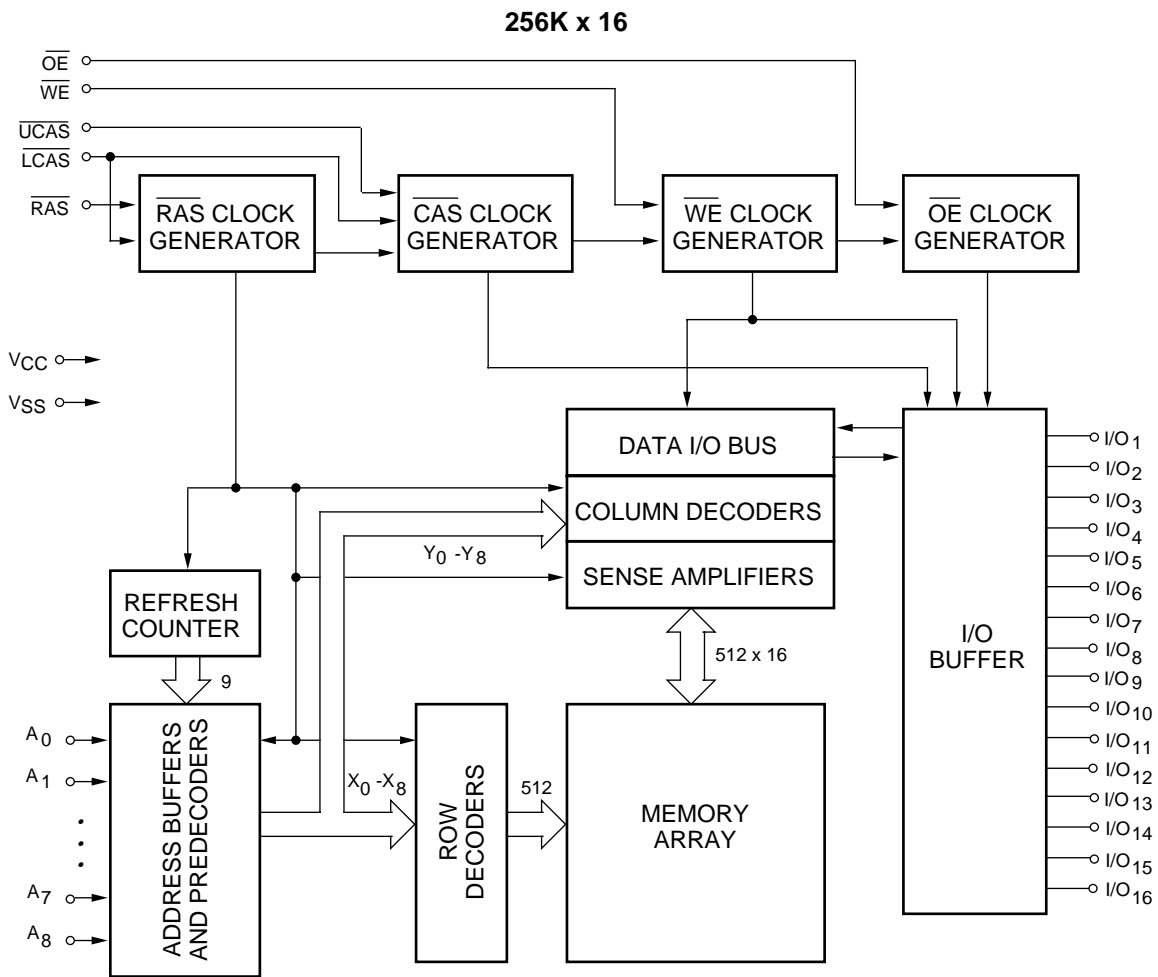
**Capacitance\***

T<sub>A</sub> = 25°C, V<sub>CC</sub> = 5.0 V ± 10%, V<sub>SS</sub> = 0 V

Symbol	Parameter	Typ.	Max.	Unit
C <sub>IN1</sub>	Address Input	3	4	pF
C <sub>IN2</sub>	$\overline{\text{RAS}}$ , $\overline{\text{UCAS}}$ , $\overline{\text{LCAS}}$ , $\overline{\text{WE}}$ , $\overline{\text{OE}}$	4	5	pF
C <sub>OUT</sub>	Data Input/Output	5	7	pF

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

**Block Diagram**



**DC and Operating Characteristics (1-2)**

$T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{CC} = 5\text{V} \pm 5\%$ ,  $V_{SS} = 0\text{V}$ , unless otherwise specified.

Symbol	Parameter	Access Time	V53C16256SH			Unit	Test Conditions	Notes
			Min.	Typ.	Max.			
$I_{LI}$	Input Leakage Current (any input pin)		-10		10	$\mu\text{A}$	$V_{SS} \leq V_{IN} \leq V_{CC}$	
$I_{LO}$	Output Leakage Current (for High-Z State)		-10		10	$\mu\text{A}$	$V_{SS} \leq V_{OUT} \leq V_{CC}$ RAS, CAS at $V_{IH}$	
$I_{CC1}$	$V_{CC}$ Supply Current, Operating	40			180	mA	$t_{RC} = t_{RC}(\text{min.})$	1, 2
		50			160			
$I_{CC2}$	$V_{CC}$ Supply Current, TTL Standby				2	mA	$\overline{\text{RAS}}, \overline{\text{CAS}}$ at $V_{IH}$ other inputs $\geq V_{SS}$	
$I_{CC3}$	$V_{CC}$ Supply Current, RAS-Only Refresh	40			180	mA	$t_{RC} = t_{RC}(\text{min.})$	2
		50			160			
$I_{CCS}$	Self Refresh Current				400	$\mu\text{A}$	$\overline{\text{RAS}}, \overline{\text{LCAS}}, \overline{\text{UCAS}} = 0.2\text{V}$ $A0 - A8 = V_{CC} - 0.2\text{V}$ or $0.2\text{V}$	
$I_{CC4}$	$V_{CC}$ Supply Current, Fast Page Mode Operation	40			170	mA	Minimum Cycle	1, 2
		50			150			
$I_{CC5}$	$V_{CC}$ Supply Current, Standby, Output Enabled other inputs $\geq V_{SS}$				2	mA	$\overline{\text{RAS}} = V_{IH}, \overline{\text{CAS}} = V_{IL}$	1
$I_{CC6}$	$V_{CC}$ Supply Current, CMOS Standby				1	mA	$\overline{\text{RAS}} \geq V_{CC} - 0.2\text{V}$ , $\overline{\text{CAS}} \geq V_{CC} - 0.2\text{V}$ , All other inputs $\geq V_{SS}$	
$V_{CC}$	Supply Voltage		4.75	5.0	5.25	V		
$V_{IL}$	Input Low Voltage		-1		0.8	V		3
$V_{IH}$	Input High Voltage		2.0		$V_{CC} + 1$	V		3
$V_{OL}$	Output Low Voltage				0.4	V	$I_{OL} = 2.0\text{ mA}$	
$V_{OH}$	Output High Voltage		2.4			V	$I_{OH} = -2.0\text{ mA}$	

**AC Characteristics**

$T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{CC} = 5V \pm 10\%$ ,  $V_{SS} = 0V$  unless otherwise noted

AC Test conditions, input pulse levels 0 to 3V

#	Symbol	Parameter	40		50		Unit	Notes
			Min.	Max.	Min.	Max.		
1	$t_{RAS}$	$\overline{RAS}$ Pulse Width	40	75	50	75K	ns	
2	$t_{RC}$	Read or Write Cycle Time	75		90		ns	
3	$t_{RP}$	$\overline{RAS}$ Precharge Time	25		30		ns	
4	$t_{CSH}$	$\overline{CAS}$ Hold Time	40		50		ns	
5	$t_{CAS}$	$\overline{CAS}$ Pulse Width	12		14		ns	
6	$t_{RCD}$	$\overline{RAS}$ to $\overline{CAS}$ Delay	17	28	19	36	ns	
7	$t_{RCS}$	Read Command Setup Time	0		0		ns	4
8	$t_{ASR}$	Row Address Setup Time	0		0		ns	
9	$t_{RAH}$	Row Address Hold Time	7		9		ns	
10	$t_{ASC}$	Column Address Setup Time	0		0		ns	
11	$t_{CAH}$	Column Address Hold Time	5		7		ns	
12	$t_{RSH (R)}$	$\overline{RAS}$ Hold Time (Read Cycle)	12		14		ns	
13	$t_{CRP}$	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5		5		ns	
14	$t_{RCH}$	Read Command Hold Time Referenced to $\overline{CAS}$	0		0		ns	5
15	$t_{RRH}$	Read Command Hold Time Referenced to $\overline{RAS}$	0		0		ns	5
16	$t_{ROH}$	$\overline{RAS}$ Hold Time Referenced to $\overline{OE}$	8		10		ns	
17	$t_{OAC}$	Access Time from $\overline{OE}$		12		14	ns	
18	$t_{CAC}$	Access Time from $\overline{CAS}$		12		14	ns	6, 7
19	$t_{RAC}$	Access Time from $\overline{RAS}$		45		55	ns	6, 8, 9
20	$t_{CAA}$	Access Time from Column Address		20		24	ns	6, 7, 10
21	$t_{LZ}$	$\overline{OE}$ or $\overline{CAS}$ to Low-Z Output	0		0		ns	16
22	$t_{HZ}$	$\overline{OE}$ or $\overline{CAS}$ to High-Z Output	0	6	0	8	ns	16
23	$t_{AR}$	Column Address Hold Time from $\overline{RAS}$	30		40		ns	
24	$t_{RAD}$	$\overline{RAS}$ to Column Address Delay Time	12	20	14	26	ns	11
25	$t_{RSH (W)}$	$\overline{RAS}$ or $\overline{CAS}$ Hold Time in Write Cycle	12		14		ns	
26	$t_{CWL}$	Write Command to $\overline{CAS}$ Lead Time	12		14		ns	
27	$t_{WCS}$	Write Command Setup Time	0		0		ns	12, 13
28	$t_{WCH}$	Write Command Hold Time	5		7		ns	
29	$t_{WP}$	Write Pulse Width	5		7		ns	
30	$t_{WCR}$	Write Command Hold Time from $\overline{RAS}$	30		40		ns	
31	$t_{RWL}$	Write Command to $\overline{RAS}$ Lead Time	12		14		ns	
32	$t_{DS}$	Data in Setup Time	0		0		ns	14

**AC Characteristics** (Cont'd)

#	Symbol	Parameter	40		50		Unit	Notes
			Min.	Max.	Min.	Max.		
33	t <sub>DH</sub>	Data in Hold Time	5		7		ns	14
34	t <sub>WOH</sub>	Write to $\overline{OE}$ Hold Time	6		8		ns	14
35	t <sub>OED</sub>	$\overline{OE}$ to Data Delay Time	6		8		ns	14
36	t <sub>RWC</sub>	Read-Modify-Write Cycle Time	110		130		ns	
37	t <sub>RRW</sub>	Read-Modify-Write Cycle $\overline{RAS}$ Pulse Width	75		87		ns	
38	t <sub>CWD</sub>	$\overline{CAS}$ to $\overline{WE}$ Delay	30		34		ns	12
39	t <sub>RWD</sub>	$\overline{RAS}$ to $\overline{WE}$ Delay in Read-Modify-Write Cycle	58		68		ns	12
40	t <sub>CRW</sub>	$\overline{CAS}$ Pulse Width (RMW)	48		52		ns	
41	t <sub>AWD</sub>	Col. Address to $\overline{WE}$ Delay	38		42		ns	12
42	t <sub>PC</sub>	Fast Page Mode Read or Write Cycle Time	23		28		ns	
43	t <sub>CP</sub>	$\overline{CAS}$ Precharge Time	5		7		ns	
44	t <sub>CAR</sub>	Column Address to $\overline{RAS}$ Setup Time	20		24		ns	
45	t <sub>CAP</sub>	Access Time from Column Precharge		22		27	ns	7
46	t <sub>DHR</sub>	Data in Hold Time Referenced to $\overline{RAS}$	30		40		ns	
47	t <sub>CSR</sub>	$\overline{CAS}$ Setup Time $\overline{CAS}$ -before- $\overline{RAS}$ Refresh	10		10		ns	
48	t <sub>RPC</sub>	$\overline{RAS}$ to $\overline{CAS}$ Precharge Time	0		0		ns	
49	t <sub>CHR</sub>	$\overline{CAS}$ Hold Time $\overline{CAS}$ -before- $\overline{RAS}$ Refresh	8		12		ns	
50	t <sub>PCM</sub>	Fast Page Mode Read-Modify-Write Cycle Time	60		70		ns	
51	t <sub>T</sub>	Transition Time (Rise and Fall)	3	50	3	50	ns	15
52	t <sub>REF</sub>	Refresh Interval (512 Cycles)	8			8	ms	17
53	t <sub>REF</sub>	Self Refresh	8			8	ms	
54	t <sub>RASS</sub>	RAS Pulse Width During Self Refresh	100		100		$\mu$ s	18
55	t <sub>RPS</sub>	RAS Precharge Time During Self Refresh	100		100		ns	18
56	t <sub>CHS</sub>	CAS Hold Time Width During Self Refresh	100		100		ns	18
57	t <sub>CHD</sub>	CAS Low Time During Self Refresh	100		100		ns	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  $I_{CC}$  (max.) is measured with a maximum of two transitions per address cycle in Fast 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.)  $\geq V_{SS}$  and  $V_{IH}$  (max.)  $\leq V_{CC}$ .
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 satisfied 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 380 Ohm Thevenin equivalent).
17. An initial 200  $\mu$ s 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. One CBR refresh or complete set of row refresh cycles must be completed upon existing Self Refresh Mode.

**Truth Table**

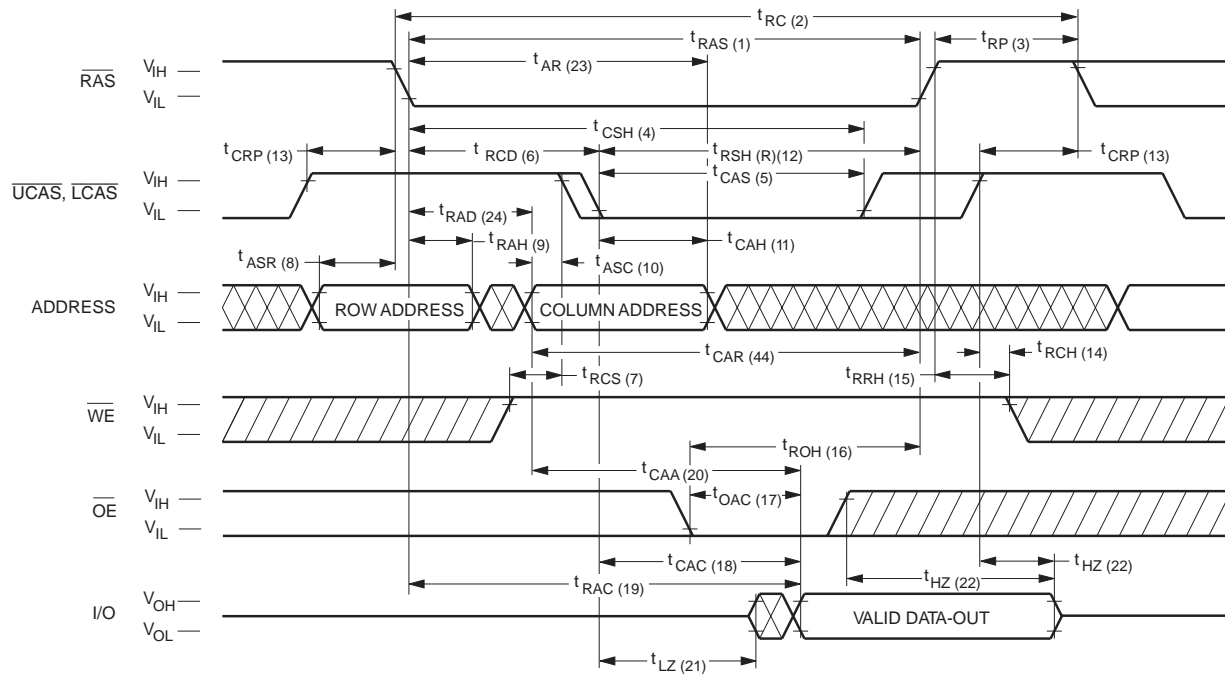
Function	RAS	LCAS	UCAS	WE	OE	ADDRESS	I/O	Notes
Standby	H	H	H	X	X	X	High-Z	
Read: Word	L	L	L	H	L	ROW/COL	Data Out	
Read: Lower Byte	L	L	H	H	L	ROW/COL	Lower Byte, Data-Out Upper Byte, High-Z	
Read: Upper Byte	L	H	L	H	L	ROW/COL	Lower Byte, High-Z Upper Byte, Data-Out	
Write: Word (Early-Write)	L	L	L	L	X	ROW/COL	Data-In	
Write: Lower Byte (Early)	L	L	H	L	X	ROW/COL	Lower Byte, Data-In Upper Byte, High-Z	
Read: Upper Byte (Early)	L	H	L	L	X	ROW/COL	Lower Byte, High-Z Upper Byte, Data-In	
Read-Write	L	L	L	H→L	L→H	ROW/COL	Data-Out, Data-In	1, 2
Fast Page-Mode Read	L	H→L	H→L	H	L	COL	Data-Out	2
Fast Page-Mode Write	L	H→L	H→L	L	X	COL	Data-In	2
Fast Page-Mode Read-Write	L	H→L	H→L	H→L	L→H	COL	Data-Out, Data-In	1, 2
Hidden Refresh Read	L→H→L	L	L	H	L	ROW/COL	Data-Out	2
RAS-Only Refresh	L	H	H	X	X	ROW	High-Z	
CBR Refresh	H→L	L	L	X	X		High-Z	3
Self Refresh	H→L	H	H	H	H		High-Z	

**Notes:**

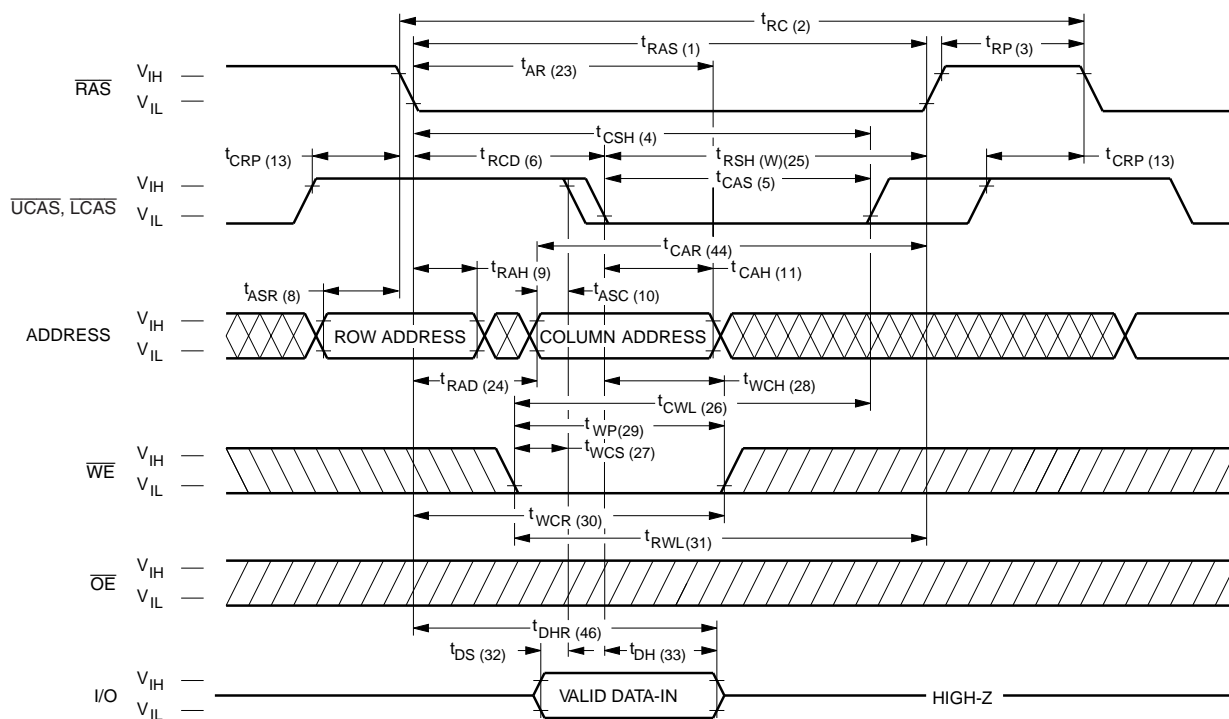
1. Byte Write cycles  $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$  active.
2. Byte Read cycles  $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$  active.
3. Only one of the two  $\overline{\text{CAS}}$  must be active ( $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$ ).



Waveforms of Read Cycle

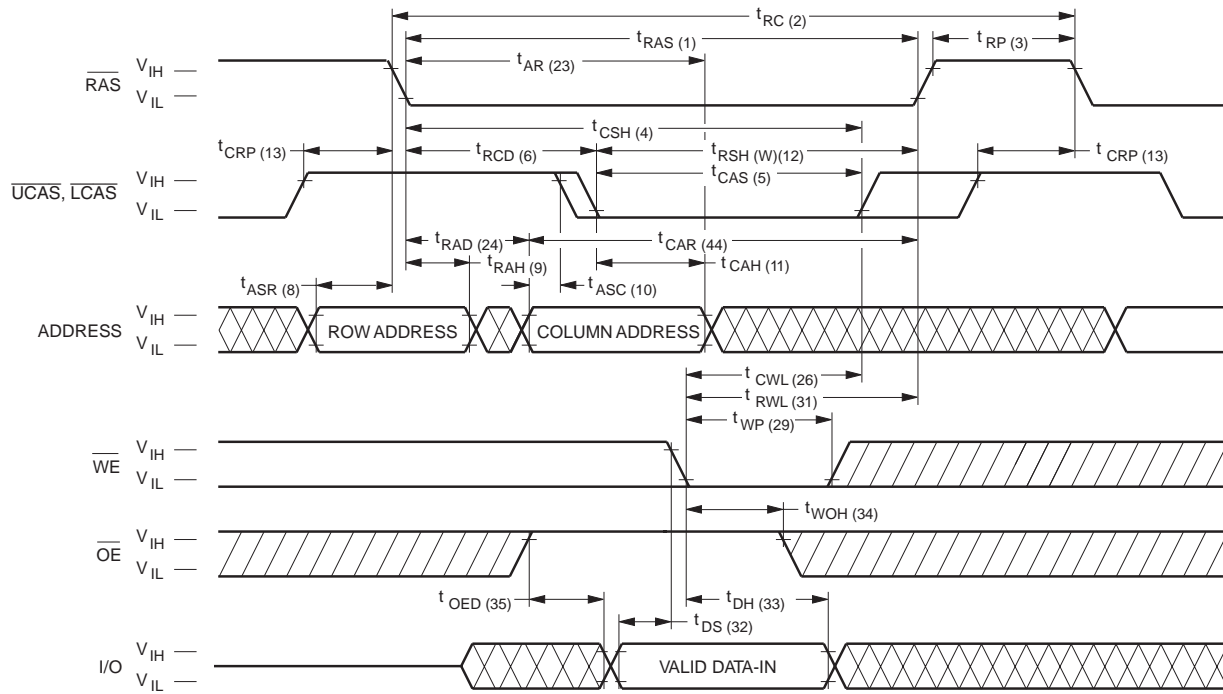


Waveforms of Early Write Cycle

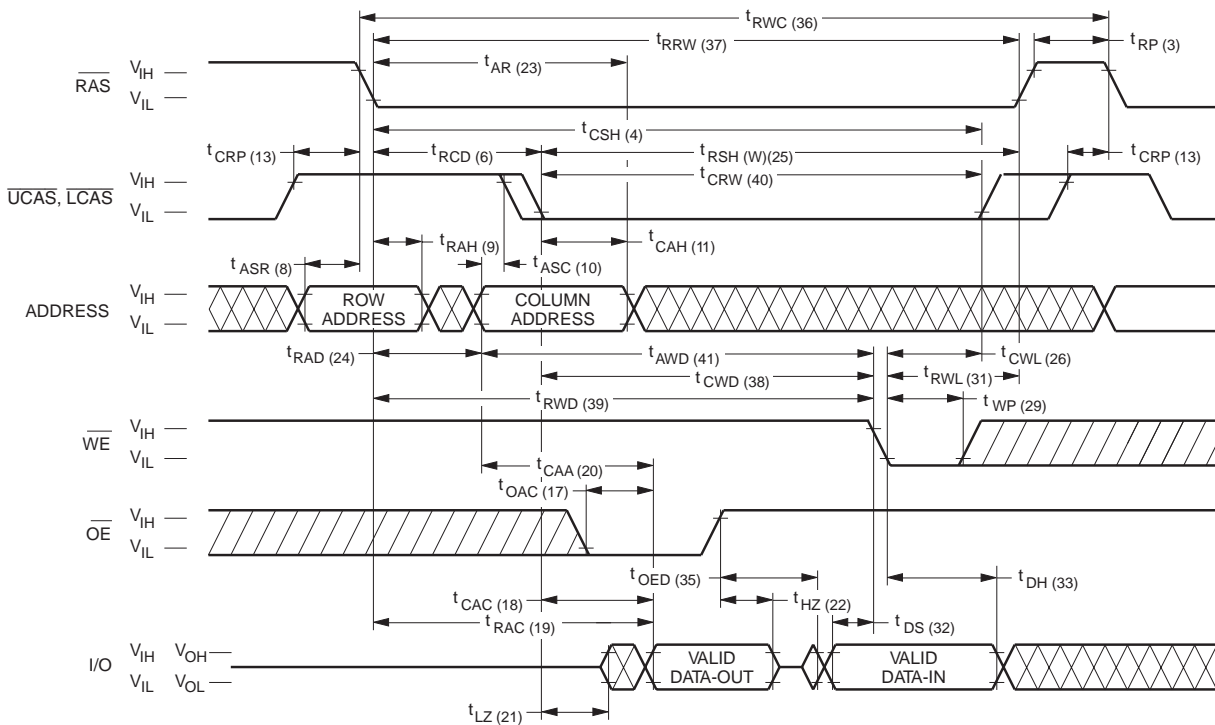


Don't Care Undefined

**Waveforms of OE-Controlled Write Cycle**

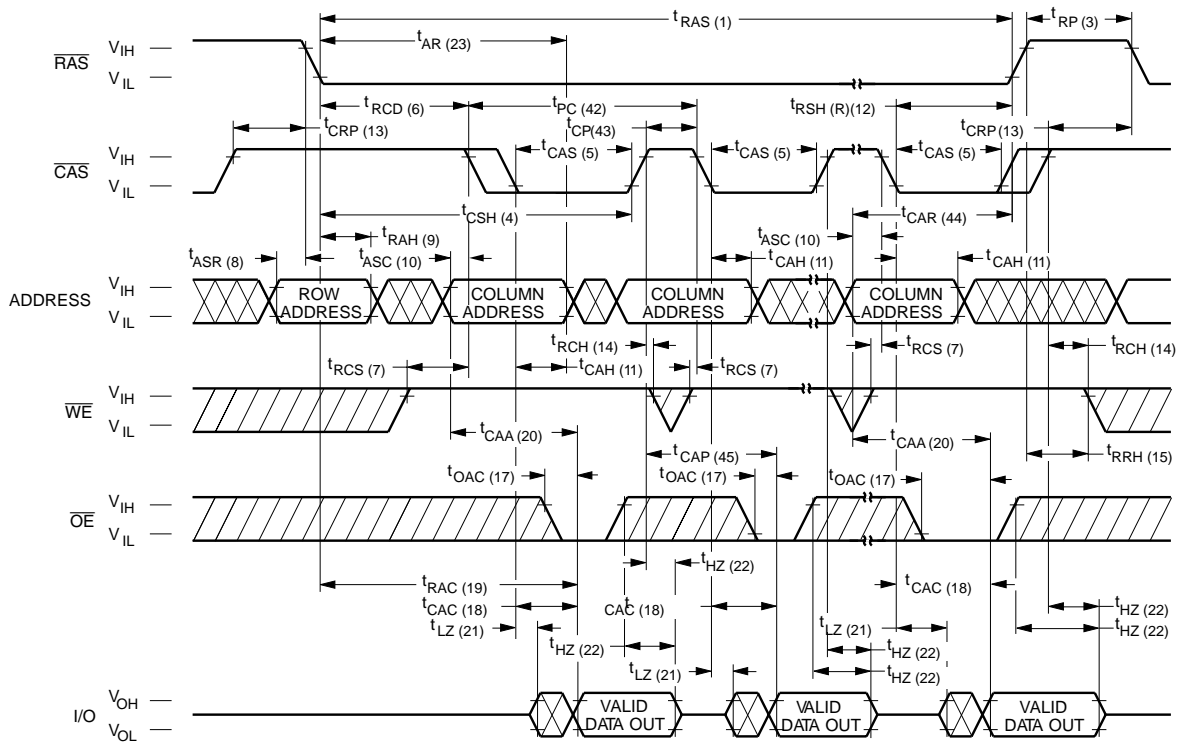


**Waveforms of Read-Modify-Write Cycle**

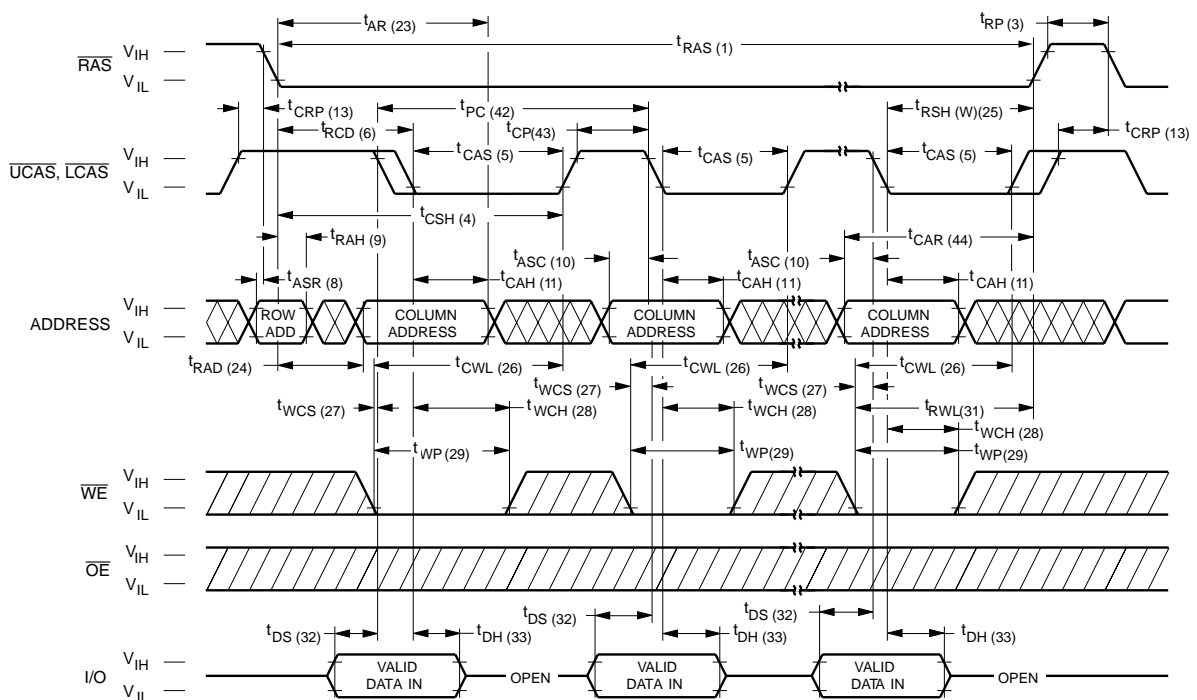


Don't Care Undefined

**Waveforms of Fast Page Mode Read Cycle**

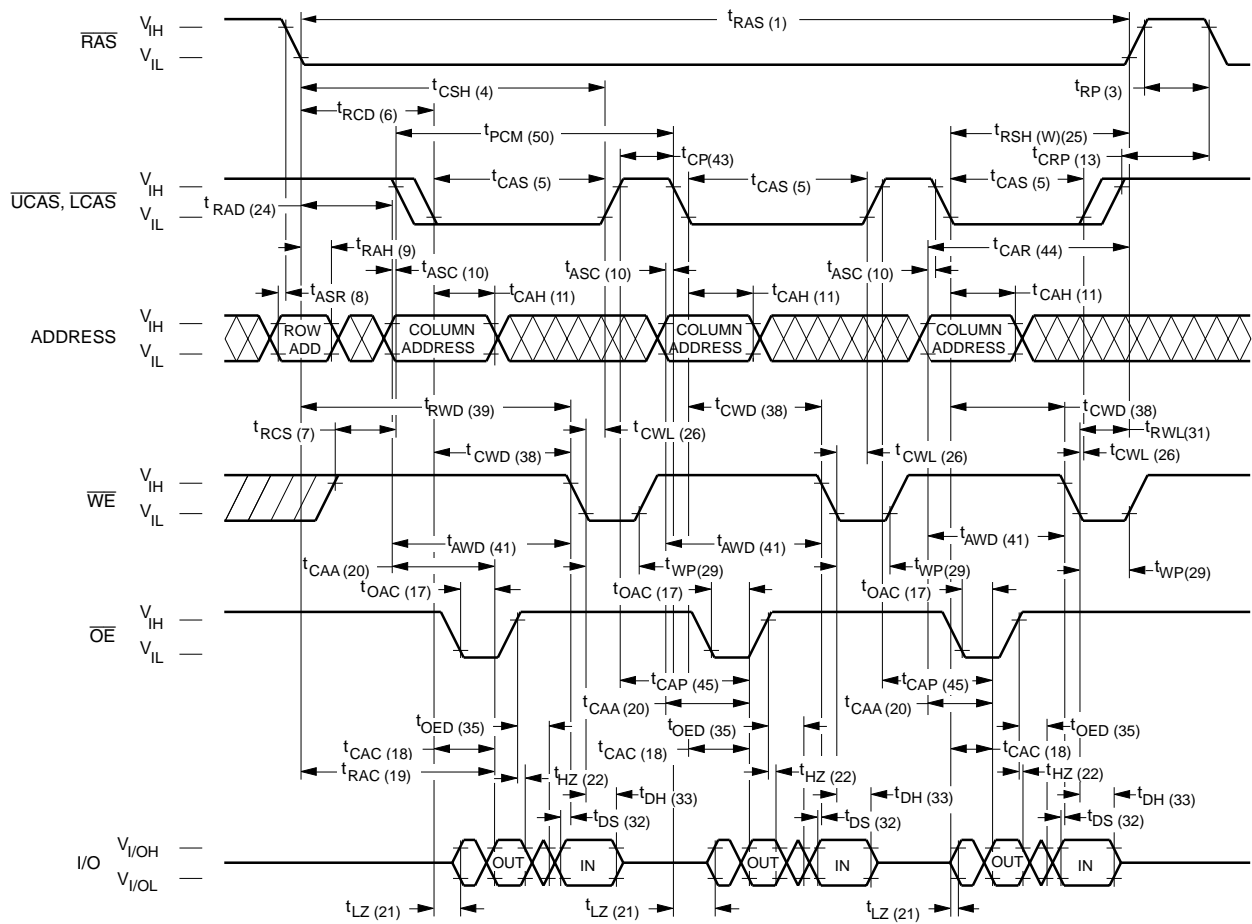


**Waveforms of Fast Page Mode Write Cycle**

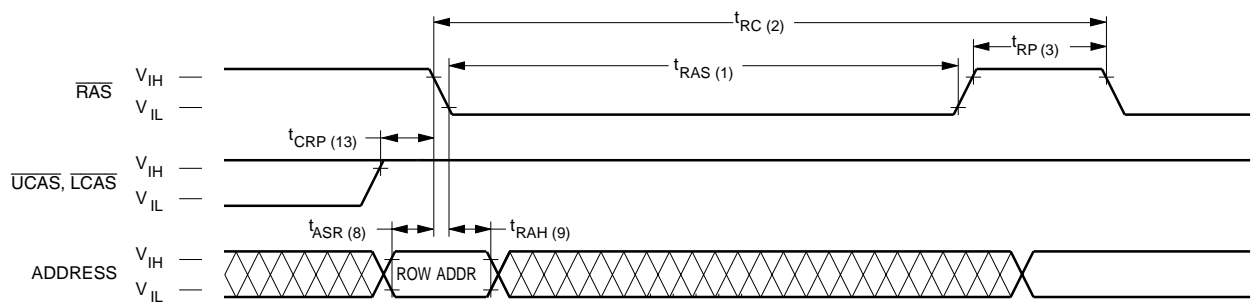


Don't Care Undefined

**Waveforms of Fast Page Mode Read-Write Cycle**



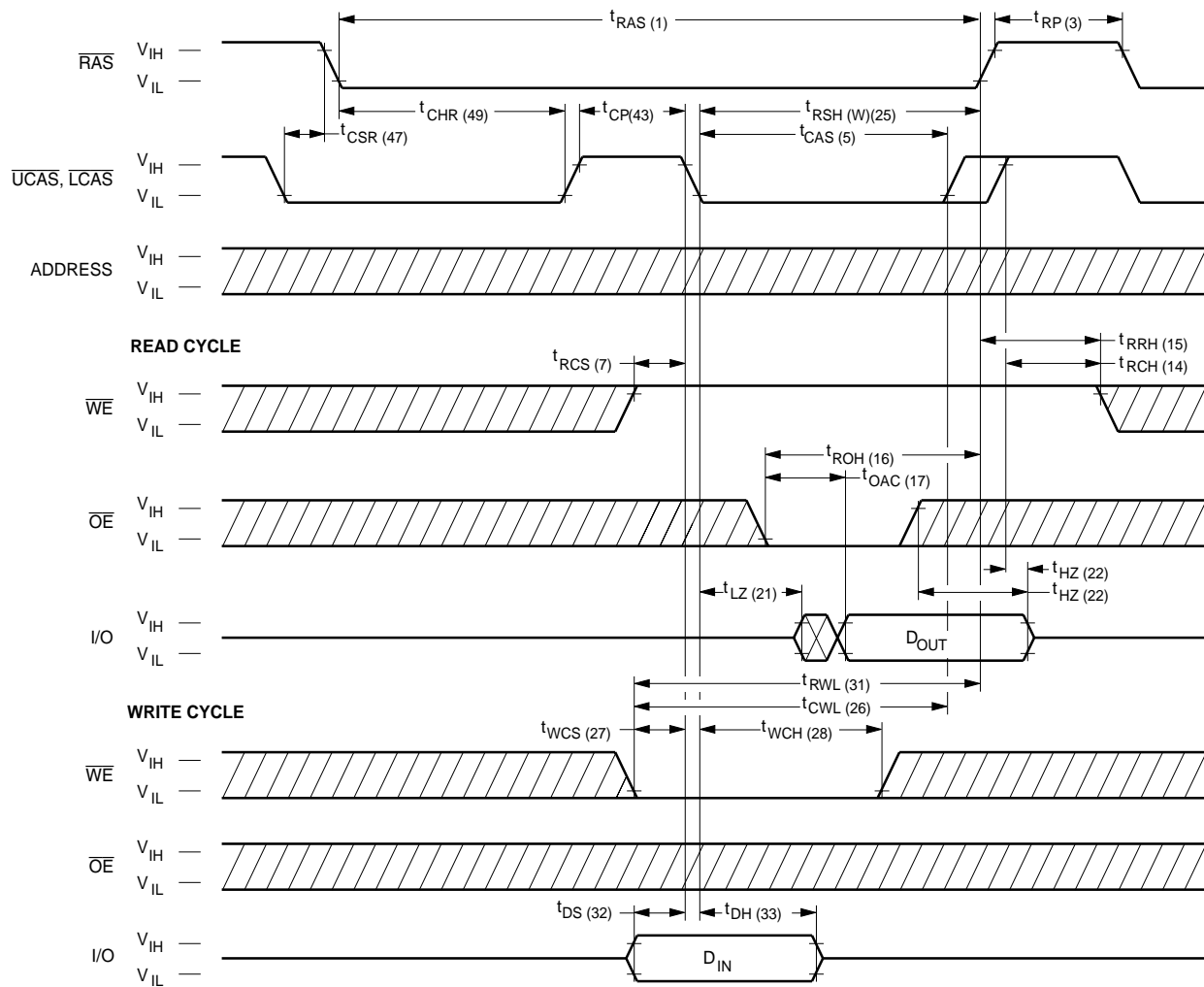
**Waveforms of RAS-Only Refresh Cycle**



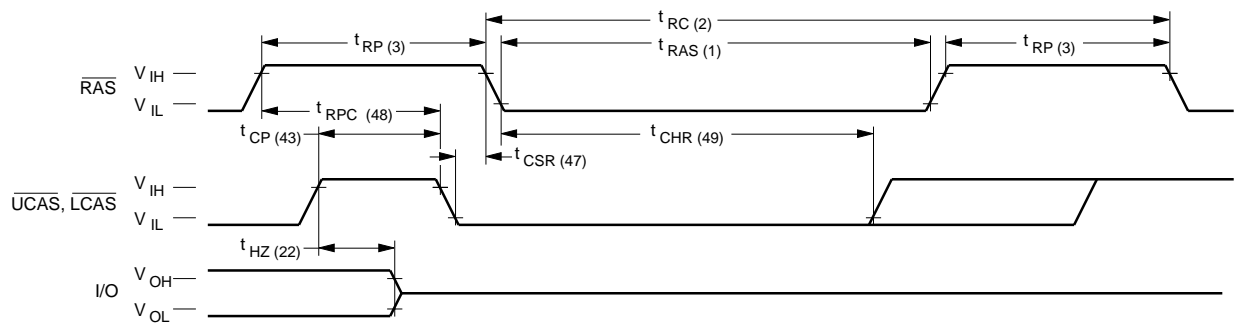
NOTE:  $\overline{WE}$ ,  $\overline{OE}$  = Don't care



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



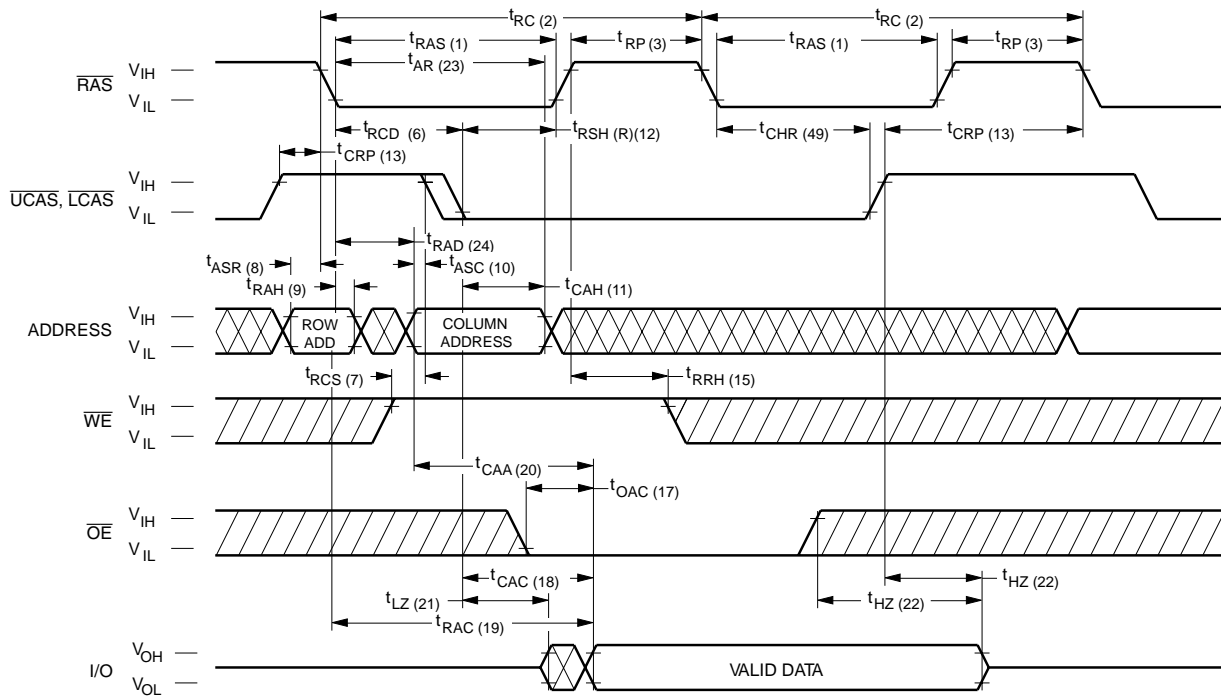
**Waveforms of  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  Refresh Cycle**



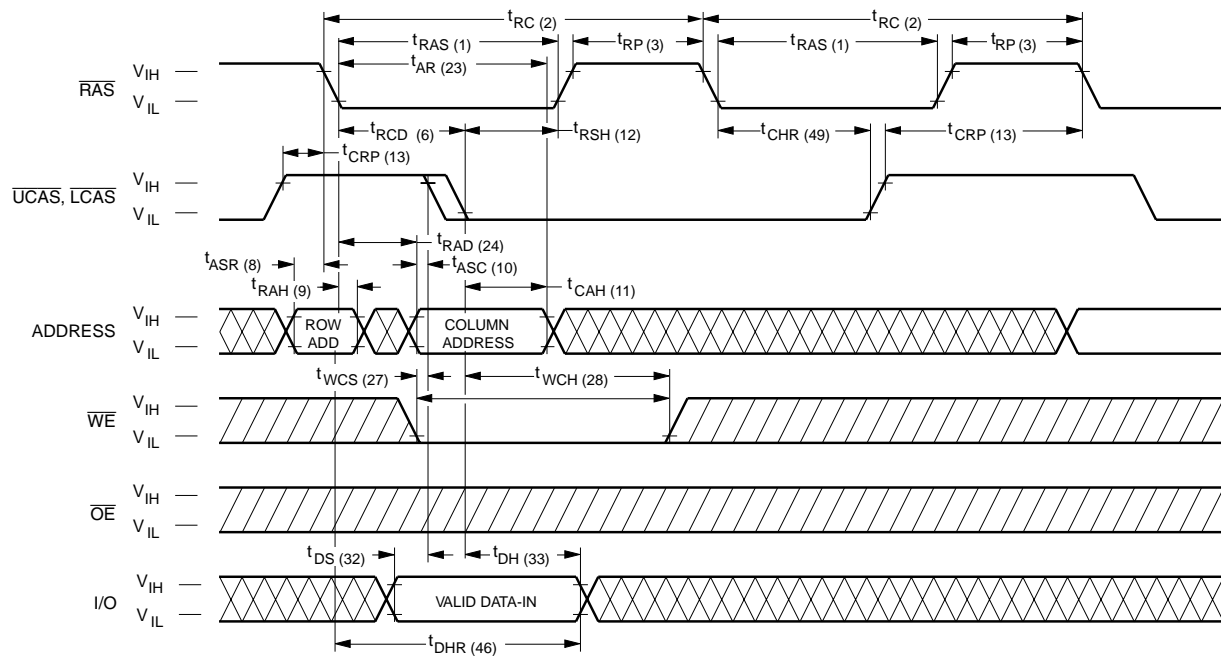
NOTE:  $\overline{\text{WE}}$ ,  $\overline{\text{OE}}$ ,  $A_0$ - $A_8$  = Don't care



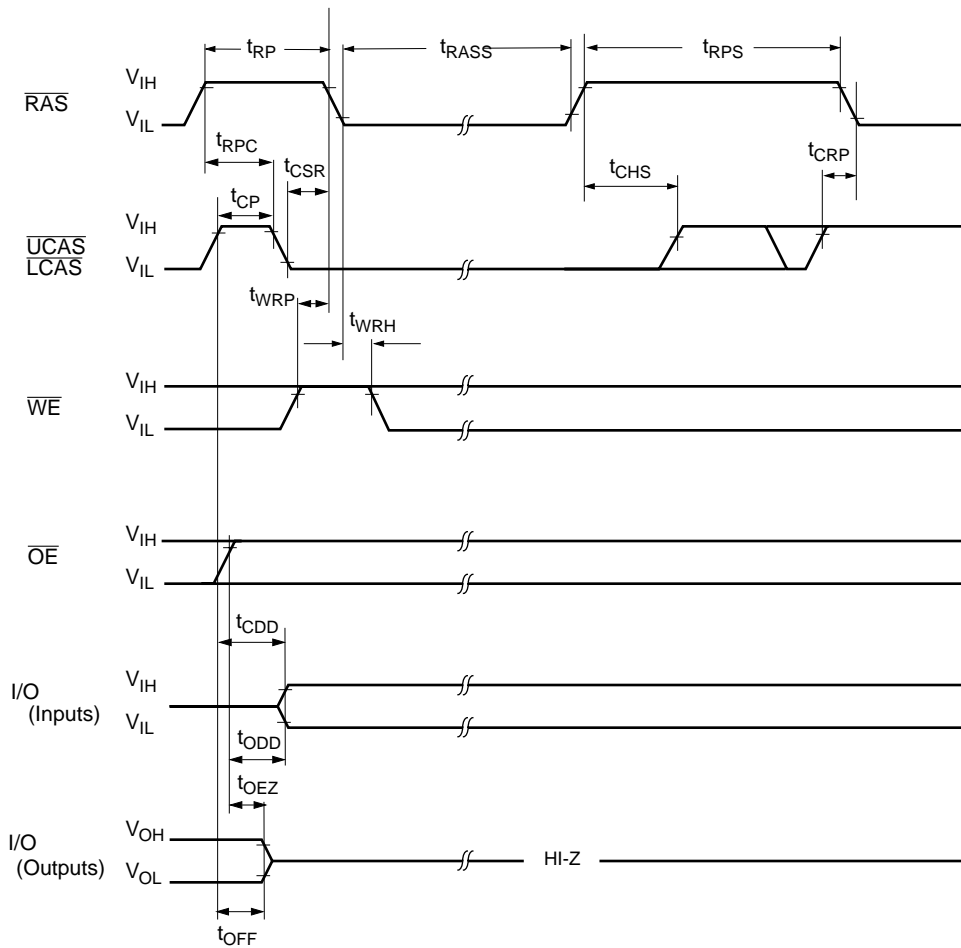
**Waveforms of Hidden Refresh Cycle (Read)**



**Waveforms of Hidden Refresh Cycle (Write)**



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



**Functional Description**

The V53C16256SH is a CMOS dynamic RAM optimized for high data bandwidth, low power applications. It is functionally similar to a traditional dynamic RAM. The V53C16256SH reads and writes data by multiplexing an 18-bit address into a 9-bit row and a 9-bit column address. The row address is latched by the Row Address Strobe ( $\overline{\text{RAS}}$ ). The column address “flows through” an internal address buffer and is latched by the Column Address Strobe ( $\overline{\text{CAS}}$ ). Because access time is primarily dependent on a valid column address rather than the precise time that the  $\overline{\text{CAS}}$  edge occurs, the delay time from  $\overline{\text{RAS}}$  to  $\overline{\text{CAS}}$  has little effect on the access time.

**Memory Cycle**

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

**Read Cycle**

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

**Write Cycle**

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

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

**Fast Page Mode Operation**

Fast Page Mode operation permits all 512 columns within a selected row of the device to be randomly accessed at a high data rate. Maintaining  $\overline{\text{RAS}}$  low while performing successive  $\overline{\text{CAS}}$  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  $\overline{\text{CAS}}$  is high. Thus, access begins from the occurrence of a valid column address rather than from the falling edge of  $\overline{\text{CAS}}$ , eliminating  $t_{\text{ASC}}$  and  $t_{\text{T}}$  from the critical timing path.  $\overline{\text{CAS}}$  latches the address into the column address buffer and acts as an output enable. During Fast Page Mode 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 Fast Page Mode, access is  $t_{\text{CAA}}$  or  $t_{\text{CAP}}$  controlled. If the column address is valid prior to the rising edge of  $\overline{\text{CAS}}$ , the access time is referenced to the  $\overline{\text{CAS}}$  rising edge and is specified by  $t_{\text{CAP}}$ . If the column address is valid after the rising  $\overline{\text{CAS}}$  edge, access is timed from the occurrence of a valid address and is specified by  $t_{\text{CAA}}$ . In both cases, the falling edge of  $\overline{\text{CAS}}$  latches the address and enables the output.

Fast Page Mode provides a sustained data rate of 43 MHz for applications that require high data rates such as bit-mapped graphics or high-speed signal processing. The following equation can be used to calculate the maximum data rate:

$$\text{Data Rate} = \frac{512}{t_{\text{RC}} + 511 \times t_{\text{PC}}}$$

**Self Refresh**

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 initiated with a  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  ( $\text{CBR}$ ) Refresh cycle, holding both  $\overline{\text{RAS}}$  low ( $t_{\text{RASS}}$ ) and  $\overline{\text{CAS}}$  low ( $t_{\text{CHD}}$ ) 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  $\overline{\text{CAS}}$  clock is no longer required to maintain Self Refresh operation.



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

### Data Output Operation

The V53C16256SH Input/Output is controlled by OE, CAS, WE and RAS. A RAS low transition enables the transfer of data to and from the selected row address in the Memory Array. A RAS high transition disables data transfer and latches the output data if the output is enabled. After a memory cycle is initiated with a RAS low transition, a CAS low transition or CAS low level enables the internal I/O path. A CAS high transition or a CAS high level disables the I/O path and the output driver if it is enabled. A CAS low transition while 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 OE high. The OE signal has no effect on any data stored in the output latches. A WE low level can also disable the output drivers when CAS is low. During a Write cycle, if WE goes low at a time in relationship to CAS that would normally cause the outputs to be active, it is necessary to use OE to disable the output drivers prior to the 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  $\mu$ s is required followed by a minimum of 8 initialization cycles (any combination of cycles containing a RAS clock). Eight initialization cycles are required after extended periods of bias without clocks (greater than the Refresh Interval).

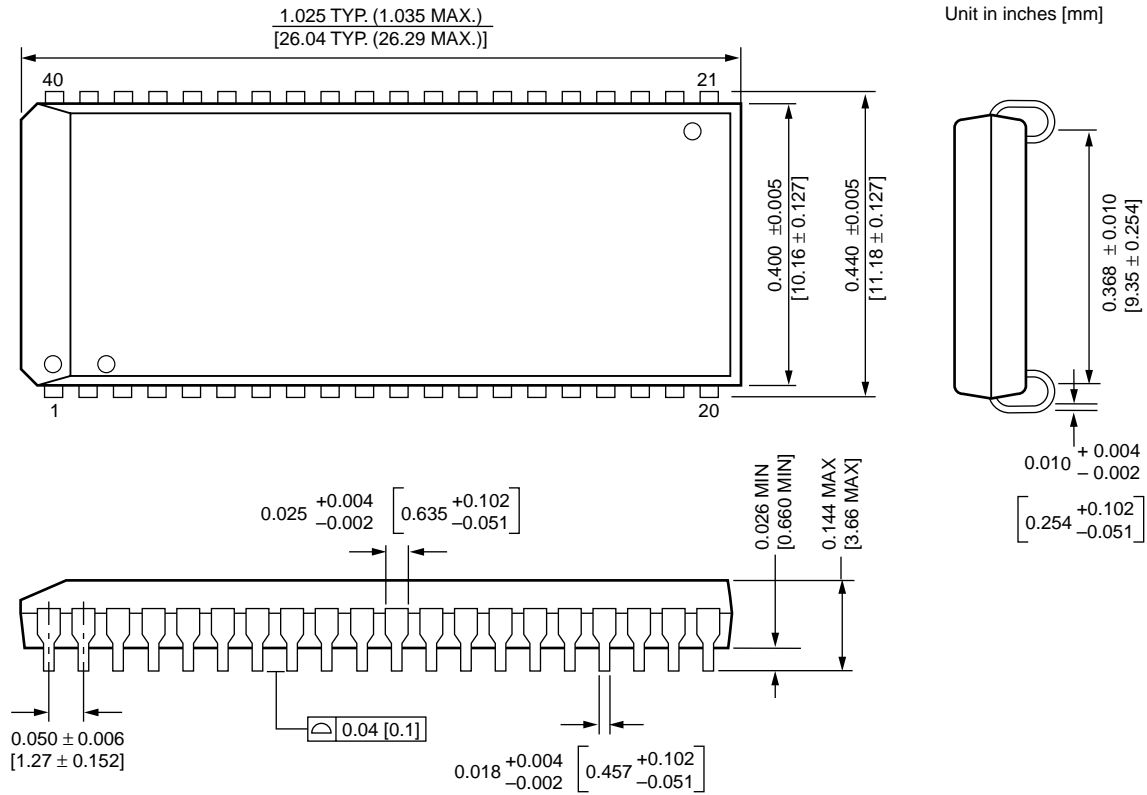
During Power-On, the  $V_{CC}$  current requirement of the V53C16256SH is dependent on the input levels of RAS and CAS. If RAS is low during Power-On, the device will go into an active cycle and  $I_{CC}$  will exhibit current transients. It is recommended that RAS and CAS track with  $V_{CC}$  or be held at a valid  $V_{IH}$  during Power-On to avoid current surges.

**Table 1. V53C16256SH Data Output Operation for Various Cycle Types**

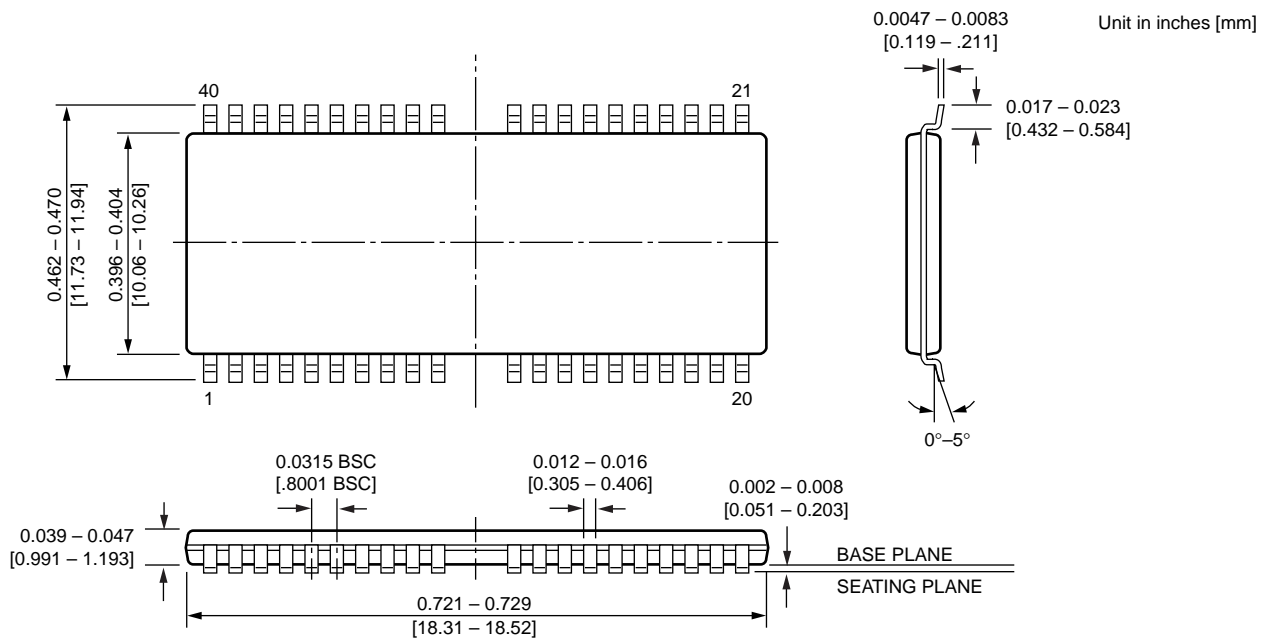
Cycle Type	I/O State
Read Cycles	Data from Addressed Memory Cell
CAS-Controlled Write Cycle (Early Write)	High-Z
WE-Controlled Write Cycle (Late Write)	OE Controlled. High OE = High-Z I/Os
Read-Modify-Write Cycles	Data from Addressed Memory Cell
Fast Page Mode Read	Data from Addressed Memory Cell
Fast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

Package Diagrams

40-Pin Plastic SOJ



40/44L-Pin TSOP-II



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