

HIGH PERFORMANCE	35	40	45	50
Max. $\overline{\text{RAS}}$ 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. Fast Page Mode Cycle Time, (t_{PC})	21 ns	23 ns	25 ns	28 ns
Min. Read/Write Cycle Time, (t_{RC})	70 ns	75 ns	80 ns	90 ns

Features

- 256K x 8-bit organization
- Fast Page Mode for a sustained data rate of 47 MHz
- $\overline{\text{RAS}}$ access time: 35, 40, 45, 50 ns
- Low power dissipation
- Read-Modify-Write, $\overline{\text{RAS}}$ -Only Refresh, $\overline{\text{CAS}}$ -Before- $\overline{\text{RAS}}$ Refresh capability
- Refresh Interval: 512 cycles/8 ms
- Single 5V \pm 10% Power Supply
- Available in 24-pin 300 mil Plastic DIP, 26/24-pin 300 mil SOJ, and 28-pin TSOP-I packages

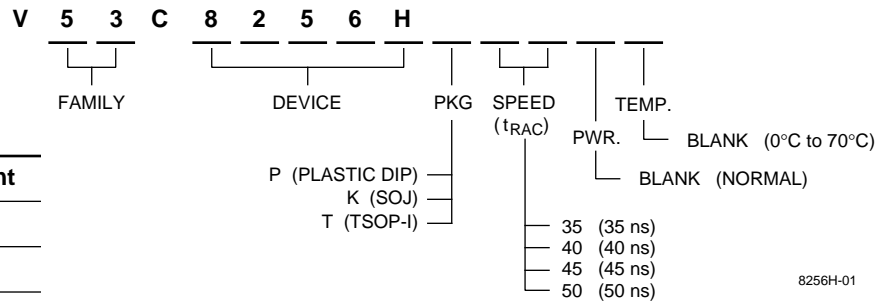
Description

The V53C8256H is a high speed 262,144 x 8 bit CMOS dynamic random access memory. The V53C8256H offers a combination of features: Fast Page Mode for high data bandwidth, fast usable speed, CMOS standby current.

All inputs and outputs are TTL compatible. Input and output capacitances are significantly lowered to allow increased system performance. Fast Page Mode operation allows random access of up to 512 (x8) bits within a row with cycle times as short as 21 ns. Because of static circuitry, the $\overline{\text{CAS}}$ clock is not in the critical timing path. The flow-through column address latches allow address pipelining while relaxing many critical system timing requirements for fast usable speed. These features make the V53C8256H ideally suited for graphics, digital signal processing and high performance computing systems.

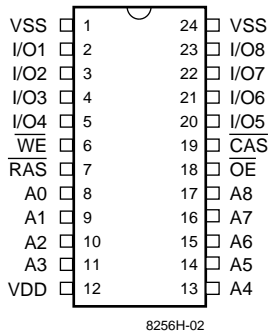
Device Usage Chart

Operating Temperature Range	Package Outline			Access Time (ns)			Power	Temperature Mark
	P	K	T	50	60	70	Std.	
0°C to 70 °C	•	•	•	•	•	•	•	Blank

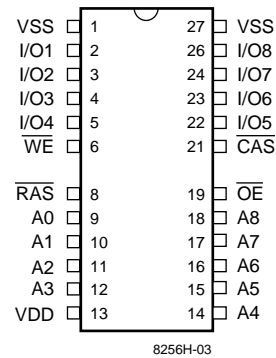


Description	Pkg.	Pin Count
Plastic DIP	P	24
SOJ	K	26/24
TSOP-I	T	28

**24-Pin Plastic DIP
PIN CONFIGURATION
Top View**



**26/24-Pin SOJ
PIN CONFIGURATION
Top View**



**28-Pin TSOP-I
PIN CONFIGURATION
Top View**

Pin Names

A ₀ -A ₈	Address Inputs
$\overline{\text{RAS}}$	Row Address Strobe
$\overline{\text{CAS}}$	Column Address Strobe
$\overline{\text{WE}}$	Write Enable
$\overline{\text{OE}}$	Output Enable
I/O ₁ -I/O ₈	Data Input, Output
V _{DD}	+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} -1.0V to +7.0V
 Data Output Current 50 mA
 Power Dissipation 1.0 W

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

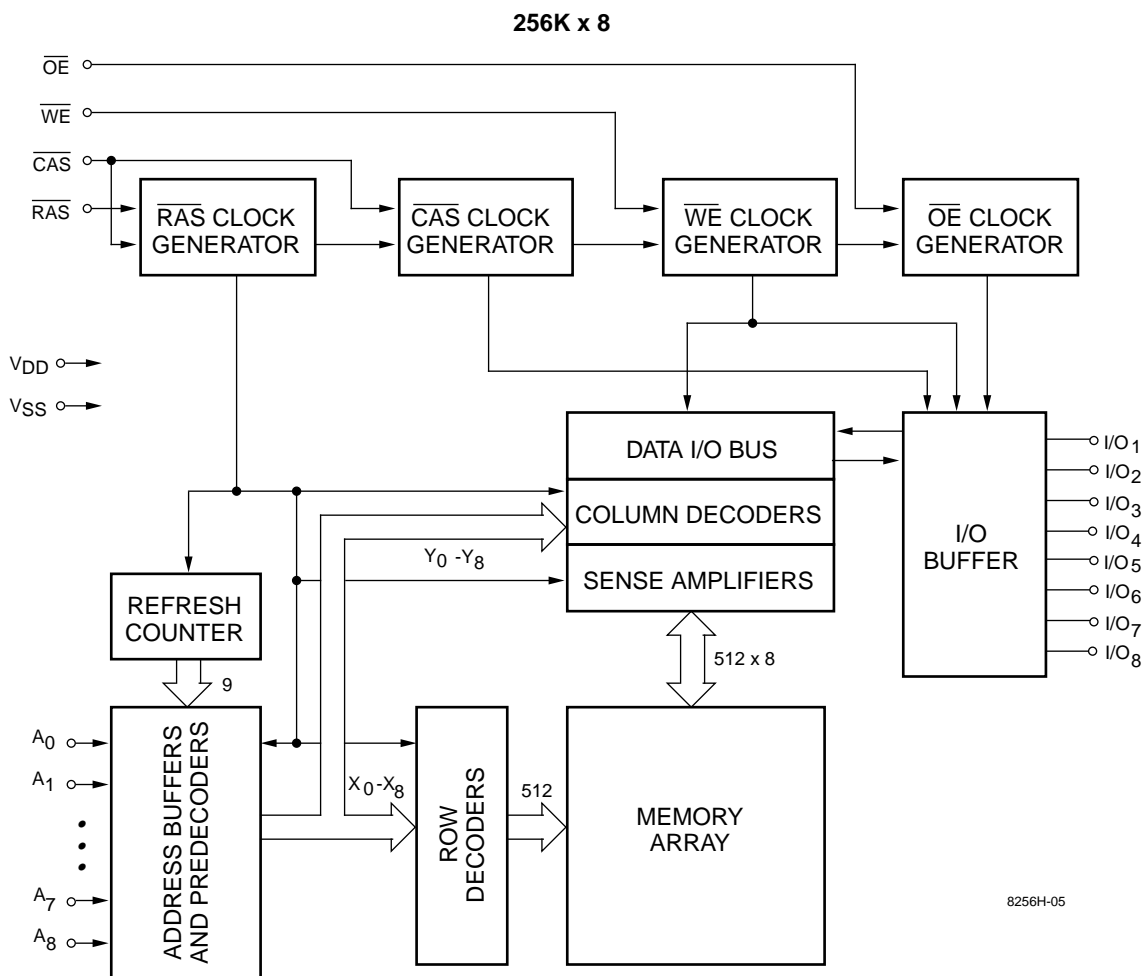
Capacitance*

T_A = 25°C, V_{DD} = 5 V ± 10%, V_{SS} = 0 V

Symbol	Parameter	Min.	Max.	Unit
C _{IN1}	Address Input	3	4	pF
C _{IN2}	$\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$	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 (1-2)

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

Symbol	Parameter	Access Time	V53C8256H			Unit	Test Conditions	Notes
			Min.	Typ.	Max.			
I_{LI}	Input Leakage Current (any input pin)		-10		10	μA	$V_{SS} \leq V_{IN} \leq V_{CC}$	
I_{LO}	Output Leakage Current (for High-Z State)		-10		10	μA	$V_{SS} \leq V_{OUT} \leq V_{CC}$ $\overline{\text{RAS}}, \overline{\text{CAS}}$ at V_{IH}	
I_{CC1}	V_{CC} Supply Current, Operating	35			160	mA	$t_{RC} = t_{RC}(\text{min.})$	1, 2
		40			150			
		45			145			
		50			135			
I_{CC2}	V_{CC} Supply Current, TTL Standby				4	mA	$\overline{\text{RAS}}, \overline{\text{CAS}}$ at V_{IH} other inputs $\geq V_{SS}$	
I_{CC3}	V_{CC} Supply Current, $\overline{\text{RAS}}$ -Only Refresh	35			160	mA	$t_{RC} = t_{RC}(\text{min.})$	2
		40			150			
		45			145			
		50			135			
I_{CC4}	V_{CC} Supply Current, Fast 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	mA	$\overline{\text{RAS}} = V_{IH}, \overline{\text{CAS}} = V_{IL}$, other inputs $\geq V_{SS}$	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_{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	$I_{OL} = 4.2\text{ mA}$	
V_{OH}	Output High Voltage		2.4			V	$I_{OH} = -5\text{ mA}$	

AC Characteristics

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

AC Test conditions, input pulse levels 0 to 3V

#	JEDEC Symbol	Symbol	Parameter	35		40		45		50		Unit	Notes
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
1	t _{RL1RH1}	t _{RAS}	RAS Pulse Width	35	75K	40	75K	45	75K	50	75K	ns	
2	t _{RL2RL2}	t _{RC}	Read or Write Cycle Time	70		75		80		90		ns	
3	t _{RH2RL2}	t _{RP}	RAS Precharge Time	25		25		25		30		ns	
4	t _{RL1CH1}	t _{CSH}	CAS Hold Time	35		40		45		50		ns	
5	t _{CL1CH1}	t _{CAS}	CAS Pulse Width	12		12		13		14		ns	
6	t _{RL1CL1}	t _{RCD}	RAS to CAS Delay	16	23	17	28	18	32	19	36	ns	
7	t _{WH2CL2}	t _{RCS}	Read Command Setup Time	0		0		0		0		ns	4
8	t _{AVRL2}	t _{ASR}	Row Address Setup Time	0		0		0		0		ns	
9	t _{RL1AX}	t _{RAH}	Row Address Hold Time	6		7		8		9		ns	
10	t _{AVCL2}	t _{ASC}	Column Address Setup Time	0		0		0		0		ns	
11	t _{CL1AX}	t _{CAH}	Column Address Hold Time	4		5		6		7		ns	
12	t _{CL1RH1(R)}	t _{RSH (R)}	RAS Hold Time (Read Cycle)	12		12		13		14		ns	
13	t _{CH2RL2}	t _{CRP}	CAS to RAS Precharge Time	5		5		5		5		ns	
14	t _{CH2WX}	t _{RCH}	Read Command Hold Time Referenced to CAS	0		0		0		0		ns	5
15	t _{RH2WX}	t _{RRH}	Read Command Hold Time Referenced to RAS	0		0		0		0		ns	5
16	t _{OEL1RH2}	t _{ROH}	RAS Hold Time Referenced to OE	8		8		9		10		ns	
17	t _{GL1QV}	t _{OAC}	Access Time from OE		12		12		13		14	ns	
18	t _{CL1QV}	t _{CAC}	Access Time from CAS		12		12		13		14	ns	6, 7
19	t _{RL1QV}	t _{RAC}	Access Time from RAS		35		40		45		50	ns	6, 8, 9
20	t _{AVQV}	t _{CAA}	Access Time from Column Address		18		20		22		24	ns	6, 7, 10
21	t _{CL1QX}	t _{LZ}	OE or CAS to Low-Z Output	0		0		0		0		ns	16
22	t _{CH2QZ}	t _{HZ}	OE or CAS to High-Z Output	0	6	0	6	0	7	0	8	ns	16
23	t _{RL1AX}	t _{AR}	Column Address Hold Time from RAS	28		30		35		40		ns	
24	t _{RL1AV}	t _{RAD}	RAS to Column Address Delay Time	11	17	12	20	13	23	14	26	ns	11
25	t _{CL1RH1(W)}	t _{RSH (W)}	RAS or CAS Hold Time in Write Cycle	12		12		13		14		ns	
26	t _{WL1CH1}	t _{CWL}	Write Command to CAS Lead Time	12		12		13		14		ns	
27	t _{WL1CL2}	t _{WCS}	Write Command Setup Time	0		0		0		0		ns	12, 13
28	t _{CL1WH1}	t _{WCH}	Write Command Hold Time	5		5		6		7		ns	

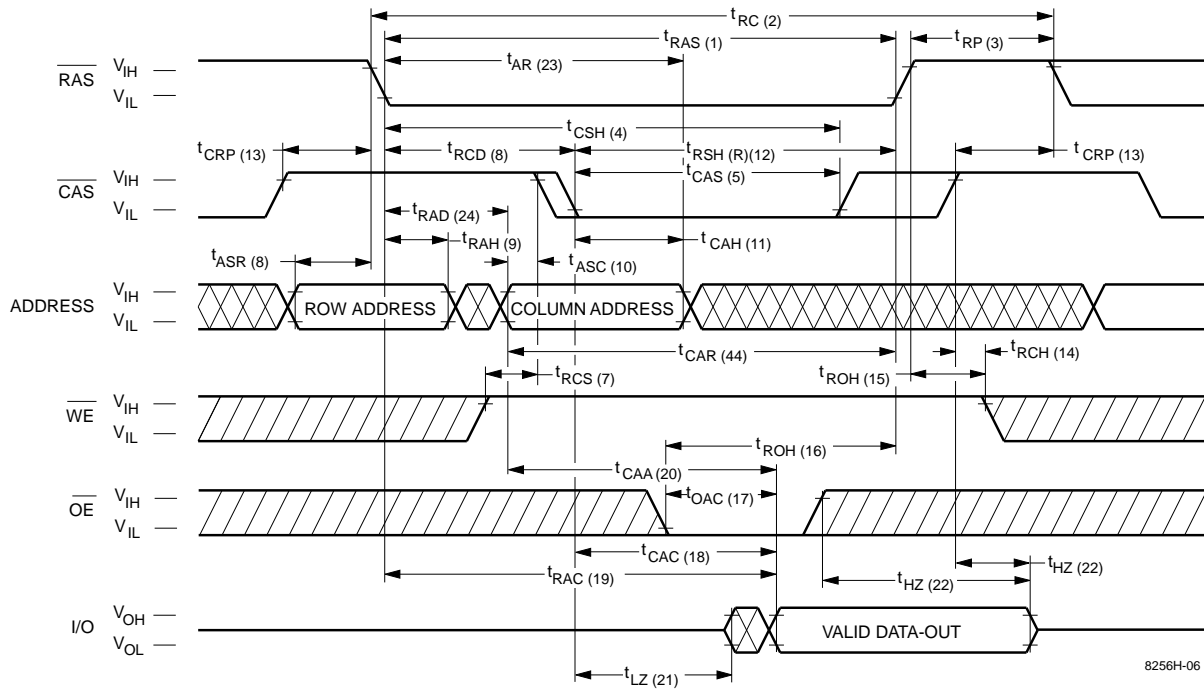
AC Characteristics (Cont'd)

#	JEDEC Symbol	Symbol	Parameter	35		40		45		50		Unit	Notes
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
29	t _{WL1WH1}	t _{WP}	Write Pulse Width	5		5		6		7		ns	
30	t _{RL1WH1}	t _{WCR}	Write Command Hold Time from RAS	28		30		35		40		ns	
31	t _{WL1RH1}	t _{RWL}	Write Command to RAS Lead Time	12		12		13		14		ns	
32	t _{DVWL2}	t _{DS}	Data in Setup Time	0		0		0		0		ns	14
33	t _{WL1DX}	t _{DH}	Data in Hold Time	4		5		6		7		ns	14
34	t _{WL1GL2}	t _{WOH}	Write to OE Hold Time	5		6		7		8		ns	14
35	t _{GH2DX}	t _{OED}	OE to Data Delay Time	5		6		7		8		ns	14
36	t _{RL2RL2 (RMW)}	t _{RWC}	Read-Modify-Write Cycle Time	105		110		115		130		ns	
37	t _{RL1RH1 (RMW)}	t _{RRW}	Read-Modify-Write Cycle RAS Pulse Width	70		75		80		87		ns	
38	t _{CL1WL2}	t _{CWD}	CAS to WE Delay	28		30		32		34		ns	12
39	t _{RL1WL2}	t _{RWD}	RAS to WE Delay in Read-Modify-Write Cycle	54		58		62		68		ns	12
40	t _{CL1CH1}	t _{CRW}	CAS Pulse Width (RMW)	46		48		50		52		ns	
41	t _{AVWL2}	t _{AWD}	Col. Address to WE Delay	35		38		41		42		ns	12
42	t _{CL2CL2}	t _{PC}	Fast Page Mode	21		23		25		28		ns	
			Read or Write Cycle Time										
43	t _{CH2CL2}	t _{CP}	CAS Precharge Time	4		5		6		7		ns	
44	t _{AVRH1}	t _{CAR}	Column Address to RAS Setup Time	18		20		22		24		ns	
45	t _{CH2QV}	t _{CAP}	Access Time from Column Precharge		20		22		24		27	ns	7
46	t _{RL1DX}	t _{DHR}	Data in Hold Time Referenced to RAS	28		30		35		40		ns	
47	t _{CL1RL2}	t _{CSR}	CAS Setup Time CAS-before-RAS Refresh	10		10		10		10		ns	
48	t _{RH2CL2}	t _{RPC}	RAS to CAS Precharge Time	0		0		0		0		ns	
49	t _{RL1CH1}	t _{CHR}	CAS Hold Time CAS-before-RAS Refresh	8		8		10		12		ns	
50	t _{CL2CL2 (RMW)}	t _{PCM}	Fast Page Mode Read-Modify-Write Cycle Time	58		60		65		70		ns	
	t _T	t _T	Transition Time (Rise and Fall)	3	50	3	50	3	50	3	50	ns	15
		t _{REF}	Refresh Interval (512 Cycles)		8		8		8		8	ms	17

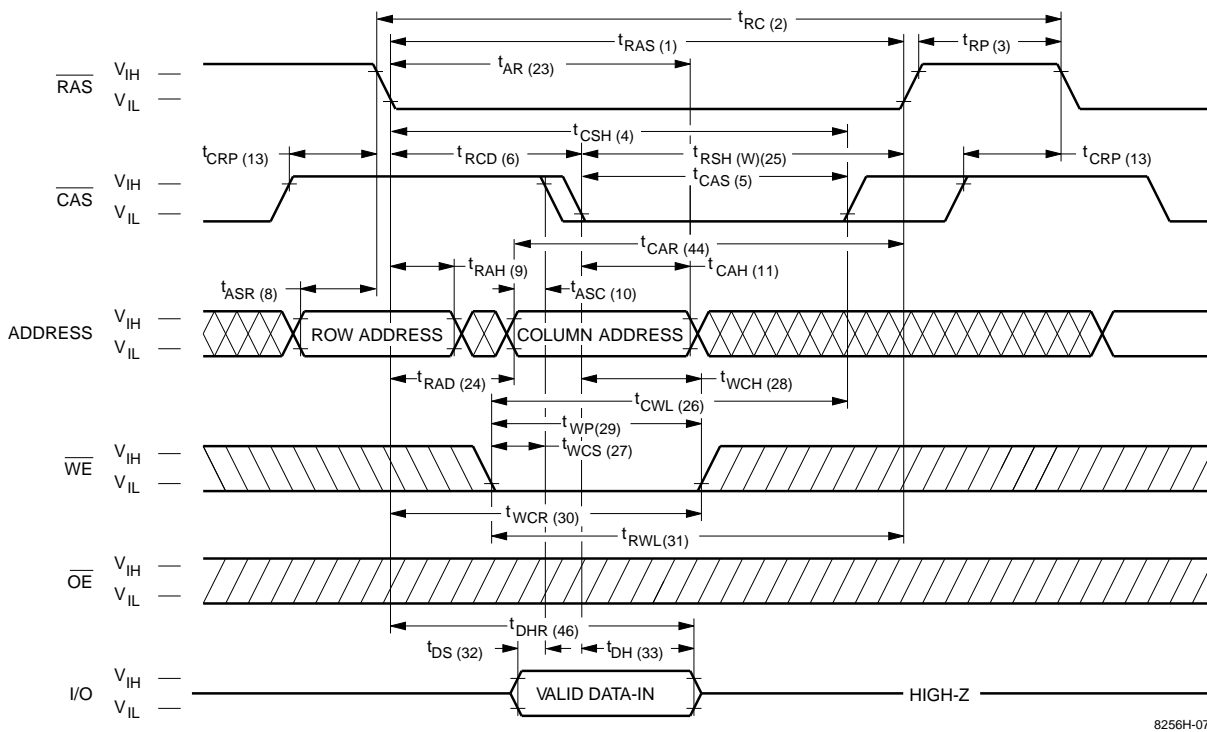
Notes:

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 two TTL inputs 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 μ 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.

Waveforms of Read Cycle

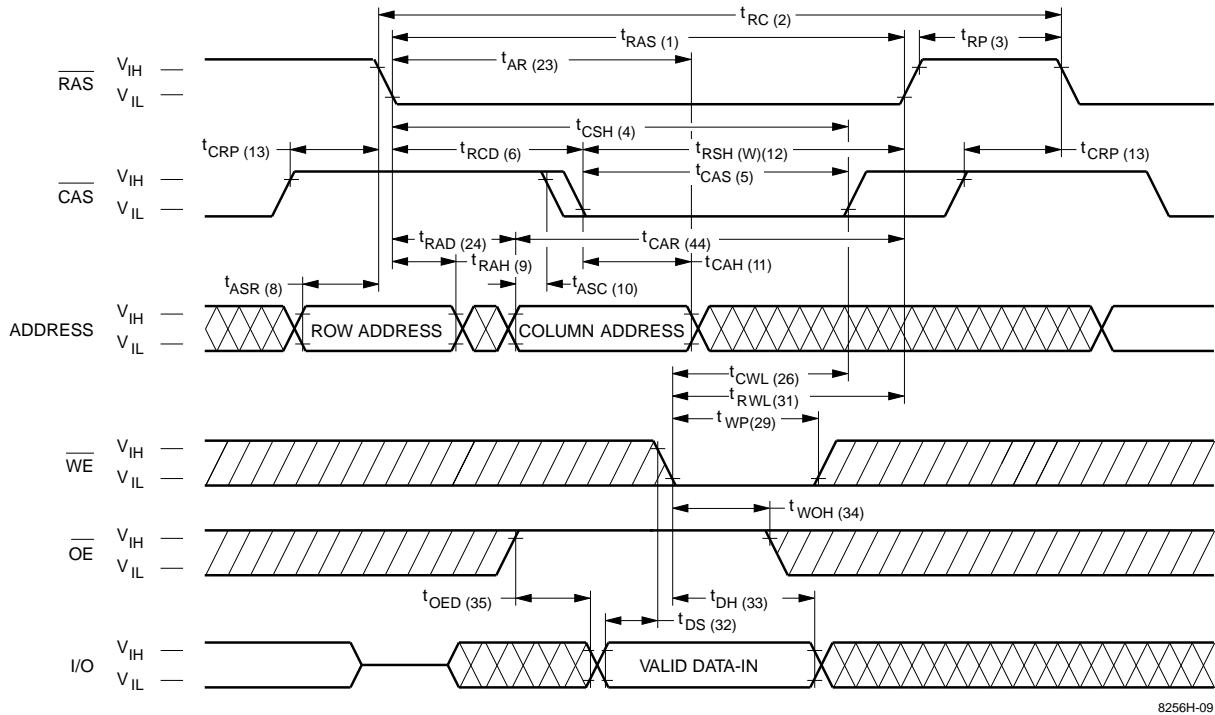


Waveforms of Early Write Cycle

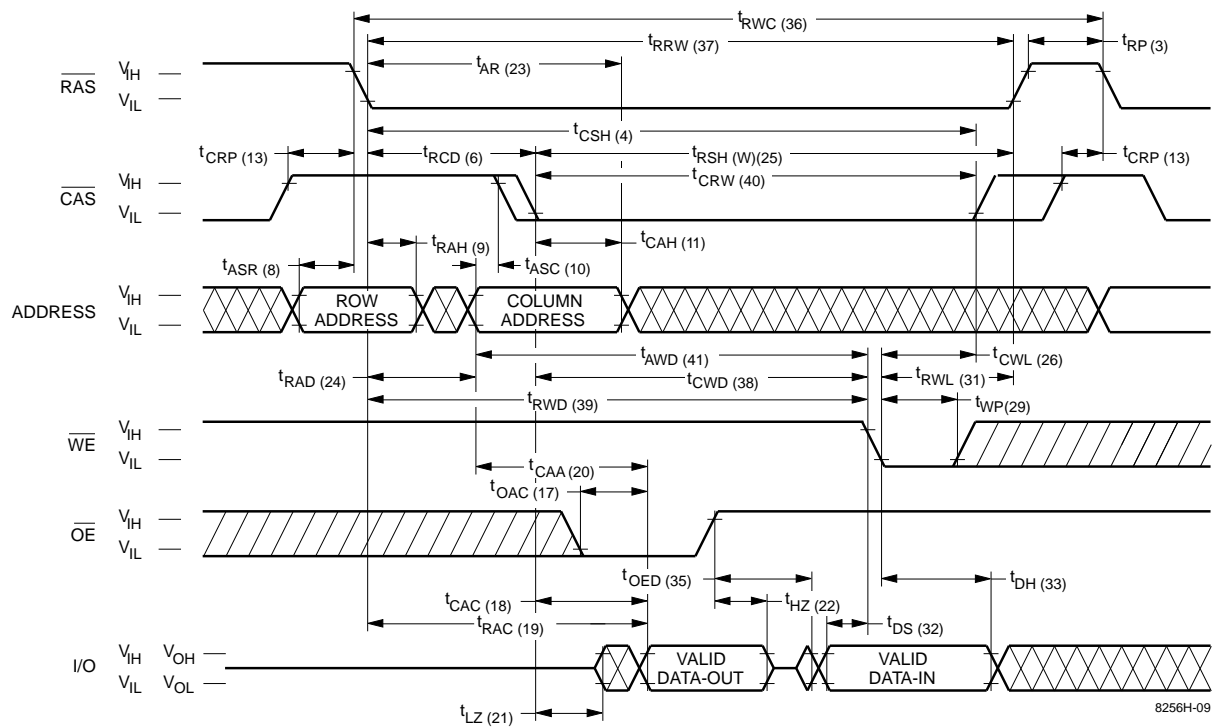


Don't Care Undefined

Waveforms of Write Cycle (OE Controlled Write)

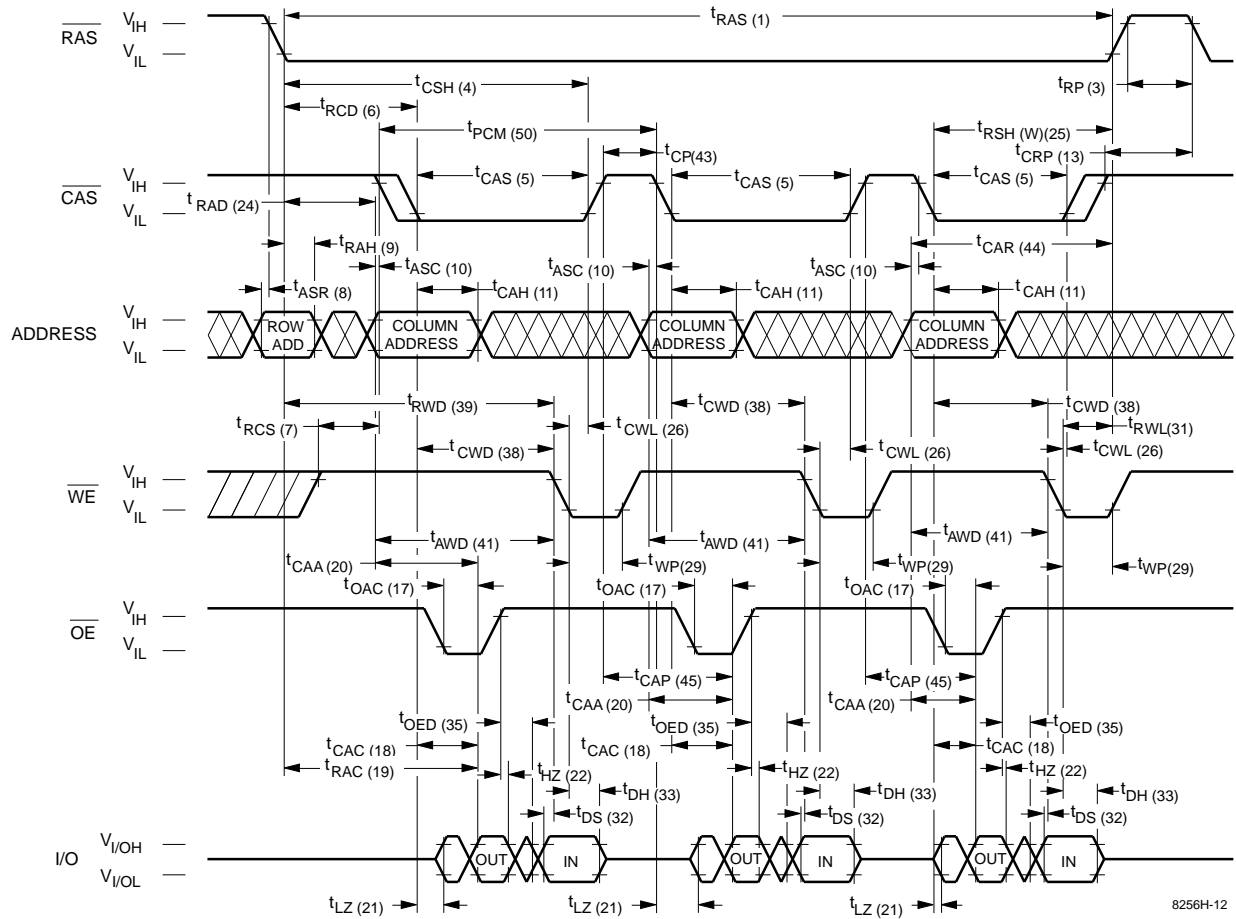


Waveforms of Read-Modify-Write Cycle



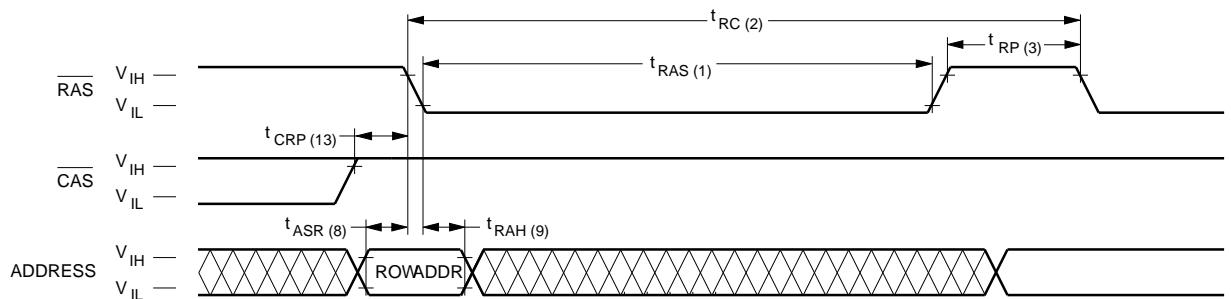
Don't Care Undefined

Waveforms of Fast Page Mode Read-Write Cycle



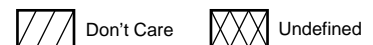
8256H-12

Waveforms of RAS Only Refresh Cycle

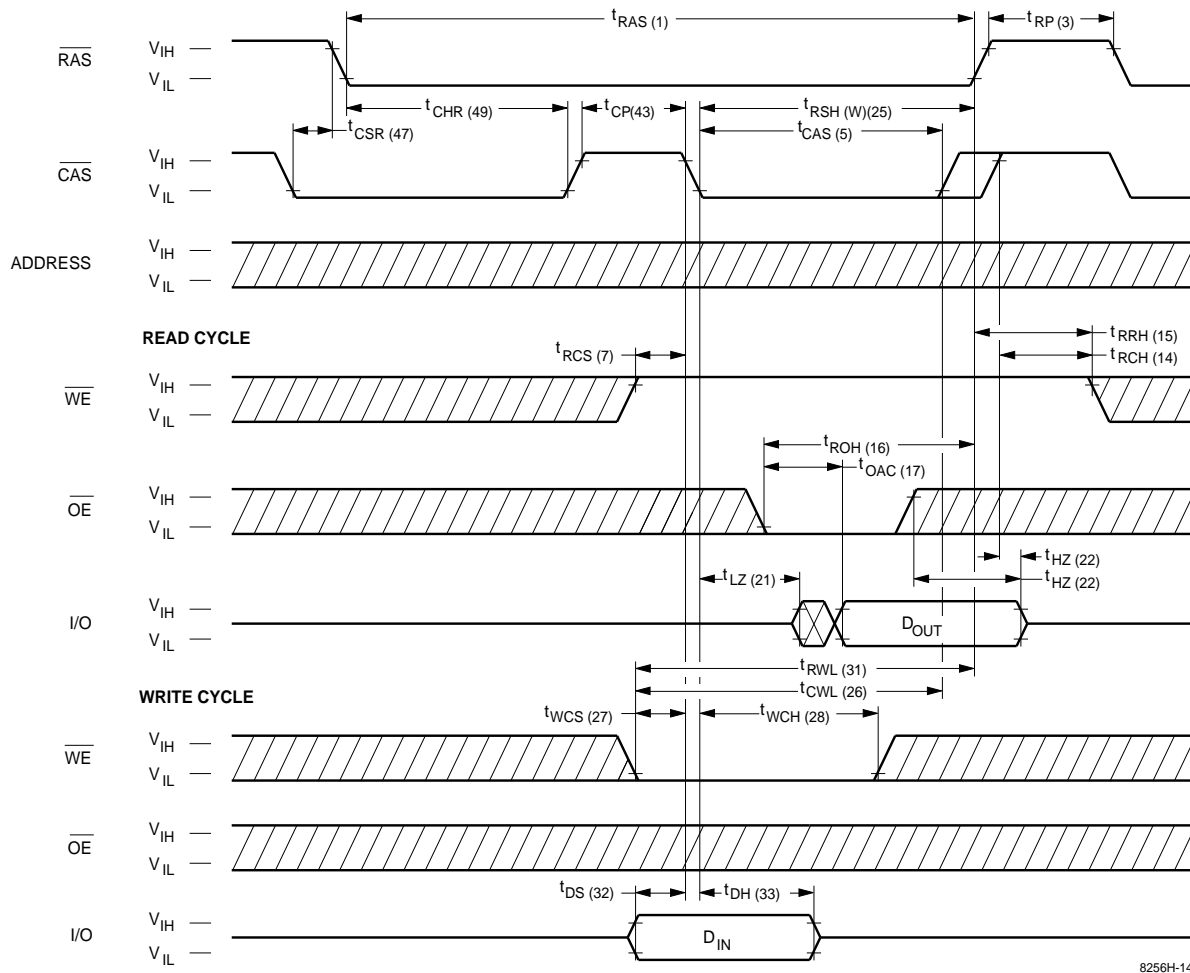


8256H-13

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

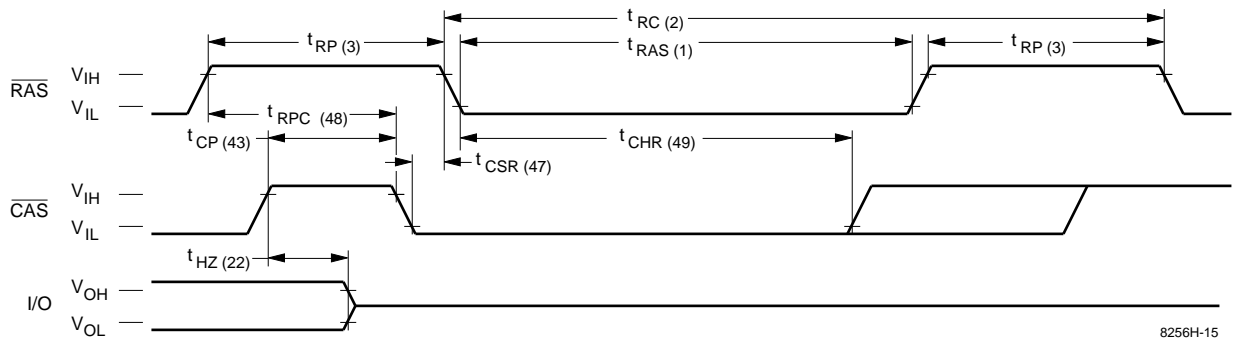


Waveforms of $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Counter Test Cycle



8256H-14

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

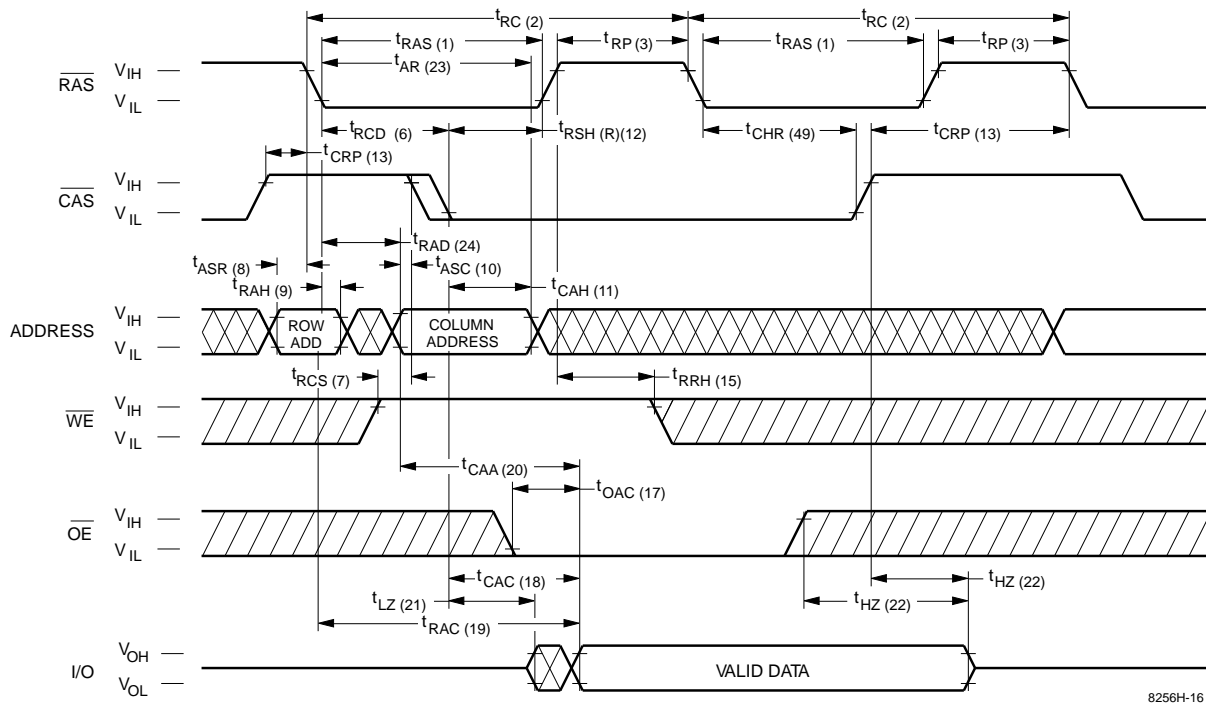


8256H-15

NOTE: $\overline{\text{WE}}$, $\overline{\text{OE}}$, A_0-A_7 = Don't care

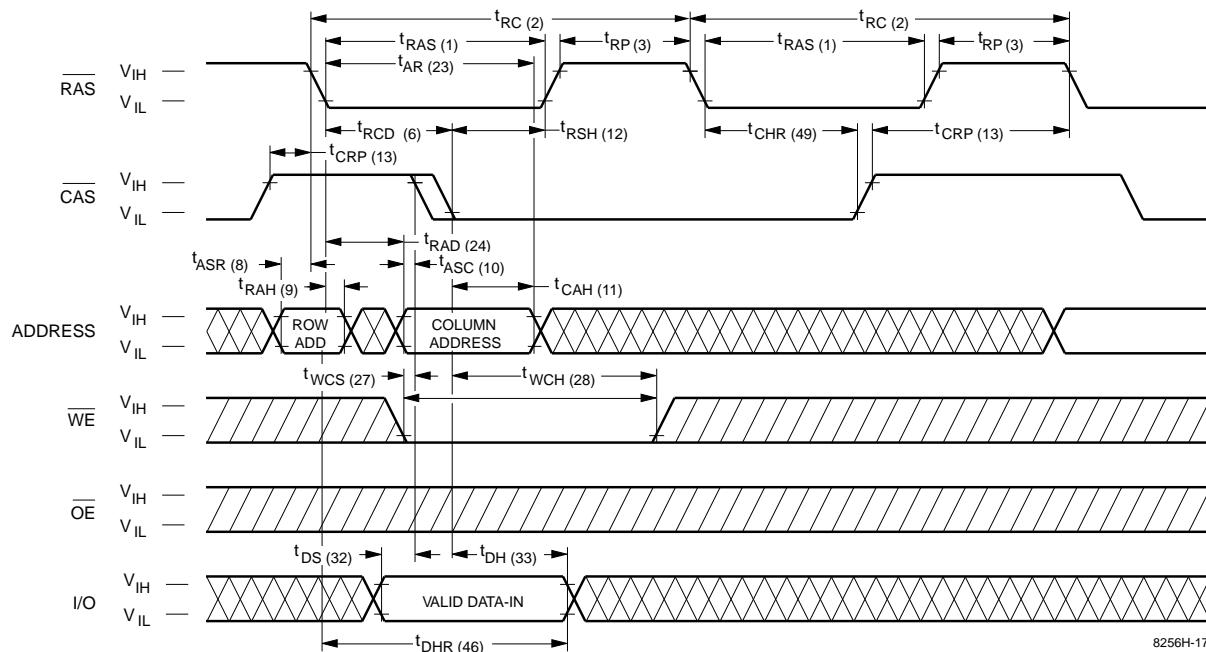


Waveforms of Hidden Refresh Cycle (Read)



8256H-16

Waveforms of Hidden Refresh Cycle (Write)



8256H-17

Don't Care Undefined

Functional Description

The V53C8256H is a CMOS dynamic RAM optimized for high data bandwidth, low power applications. It is functionally similar to a traditional dynamic RAM. The V53C8256H 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_{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_{AR} . Data Out becomes valid only when t_{OAC} , t_{RAC} , t_{CAA} and t_{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_{CAA} when t_{RAC} , t_{CAC} and t_{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_{OED} must be satisfied.

Refresh Cycle

To retain data, 512 Refresh Cycles are required in each 8 ms period. There are two ways to refresh the memory:

1. By clocking each of the 512 row addresses (A_0 through A_8) with $\overline{\text{RAS}}$ at least once every 8 ms. Any Read, Write, Read-Modify-Write or $\overline{\text{RAS}}$ -only cycle refreshes the addressed row.
2. Using a $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle. If $\overline{\text{CAS}}$ makes a transition from low to high to low after the previous cycle and before $\overline{\text{RAS}}$ falls, $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh is activated. The V53C8256H uses the output of an internal 9-bit counter as the source of row addresses and ignore external address inputs.

$\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ is a “refresh-only” mode and no data access or device selection is allowed. Thus, the output remains in the High-Z state during the cycle. A $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ counter test mode is provided to ensure reliable operation of the internal refresh counter.

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_{ASC} and t_{r} 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_{CAA} or t_{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_{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_{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 47 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:

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

Data Output Operation

The V53C8256H 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_{DD} supply, an initial pause of 200 μs 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).

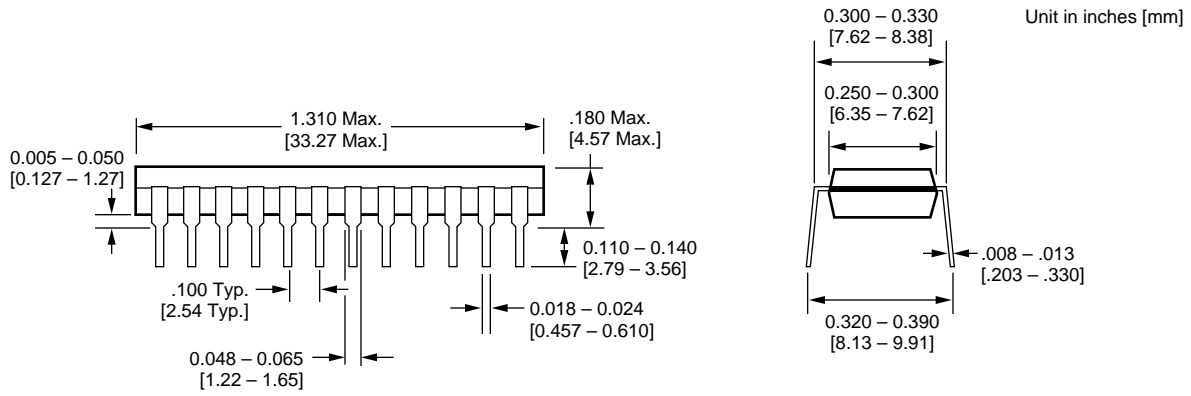
During Power-On, the V_{DD} current requirement of the V53C8256H is dependent on the input levels of RAS and CAS. If RAS is low during Power-On, the device will go into an active cycle and I_{DD} will exhibit current transients. It is recommended that RAS and CAS track with V_{DD} or be held at a valid V_{IH} during Power-On to avoid current surges.

Table 1. V53C8256H Data Output Operation for Various Cycle Types

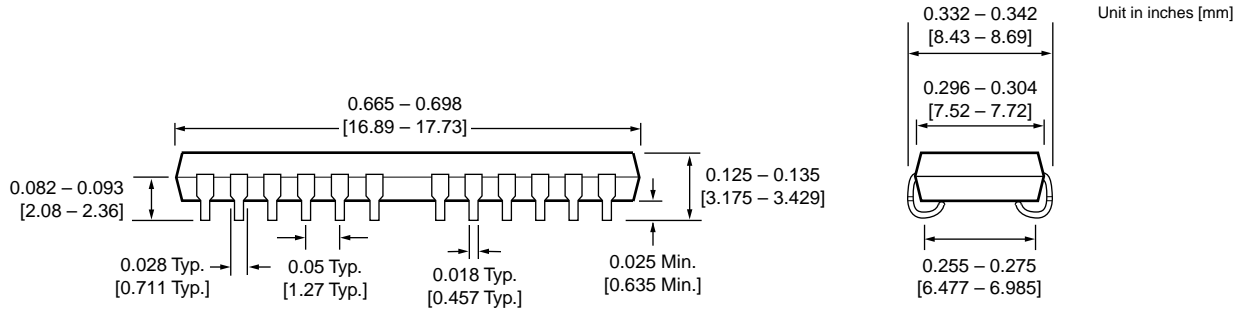
Cycle Type	I/O State
Read Cycles	Data from Addressed Memory Cell
CAS-Controlled Write Cycle (Early Write)	High-Z
WE-Controlled Write Cycle (Late Write)	OE Controlled. High OE = High-Z I/Os
Read-Modify-Write Cycles	Data from Addressed Memory Cell
Fast Page Mode Read Cycle	Data from Addressed Memory Cell
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

24-Pin 300 mil PDIP

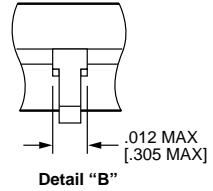
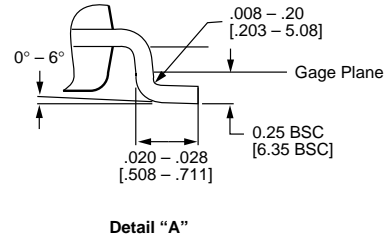
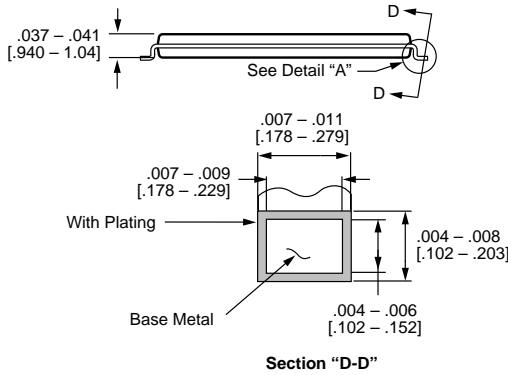
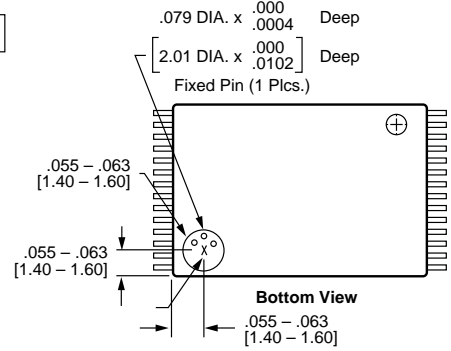
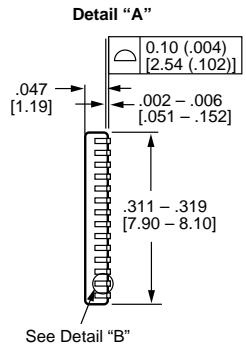
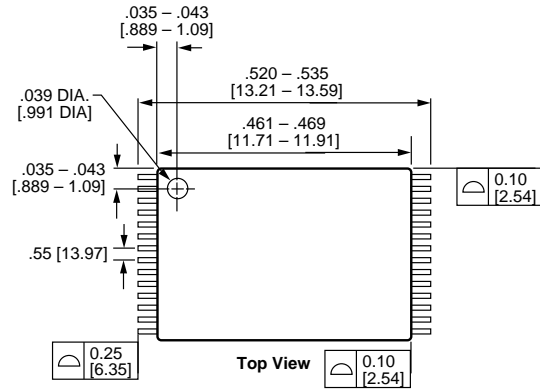


26/24-Pin 300 mil SOJ



28-Pin TSOP-I

Unit in inches [mm]



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