

HIGH PERFORMANCE	30	35	40	45	50
Max. $\overline{RAS}$ Access Time, ( $t_{RAC}$ )	30 ns	35 ns	40 ns	45 ns	50 ns
Max. Column Address Access Time, ( $t_{CAA}$ )	16 ns	18 ns	20 ns	22 ns	24 ns
Min. Extended Data Out Mode Cycle Time, ( $t_{PC}$ )	12 ns	14 ns	15 ns	17 ns	19 ns
Min. Read/Write Cycle Time, ( $t_{RC}$ )	65 ns	70 ns	75 ns	80 ns	90 ns

**Features**

- 512K x 16-bit organization
- EDO Page Mode for a sustained data rate of 83 MHz
- $\overline{RAS}$  access time: 30, 35, 40, 45, 50 ns
- Dual  $\overline{CAS}$  Inputs
- Pin-to-Pin compatible with 256K x 16
- Low power dissipation
- Read-Modify-Write,  $\overline{RAS}$ -Only Refresh,  $\overline{CAS}$ -Before- $\overline{RAS}$  Refresh
- Refresh Interval: 512 cycles/8 ms
- Available in 40-pin 400 mil SOJ and 40/44L-pin 400 mil TSOP-II packages
- Single +5V  $\pm$ 10% Power Supply
- TTL Interface

**Description**

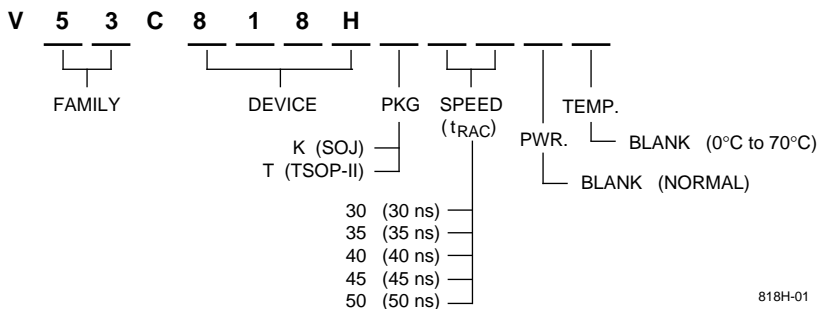
The V53C818H is a 524,288 x 16 bit high-performance CMOS dynamic random access memory. The V53C818H offers Page mode operation with Extended Data Output. An address,  $\overline{CAS}$  and  $\overline{RAS}$  input capacitances are reduced to one half when the 256K x 16 DRAM is used to construct the same memory density. The V53C818H has asymmetric address, 10-bit row and 9-bit column.

All inputs are TTL compatible. EDO Page Mode operation allows random access up to 512 x 16 bits, within a page, with cycle times as short as 15ns.

The V53C818H is ideally suited for graphics, digital signal processing and high performance peripherals.

**Device Usage Chart**

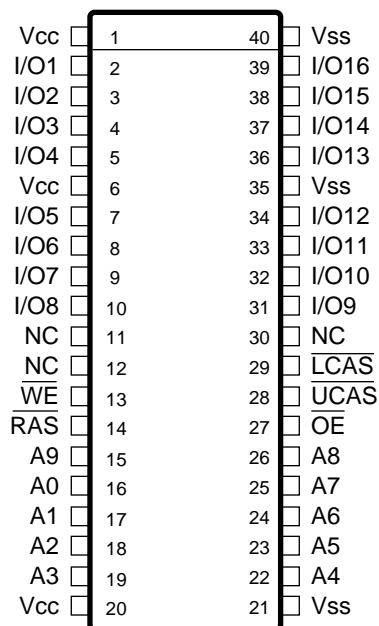
Operating Temperature Range	Package Outline		Access Time (ns)					Power	Temperature Mark
	K	T	30	35	40	45	50	Std.	
0°C to 70 °C	•	•	•	•	•	•	•	•	Blank



Description	Pkg.	Pin Count
SOJ	K	40
TSOP-II	T	40/44L

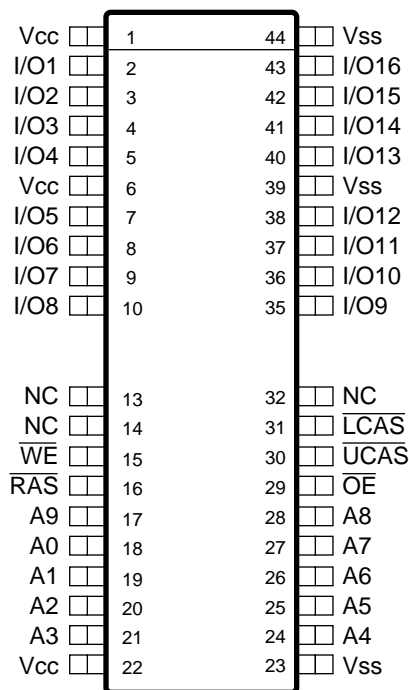
818H-01

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



818H-02

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



818H-03

**Pin Names**

A <sub>0</sub> -A <sub>9</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>	+5V 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  $V_{SS}$  ..... -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.

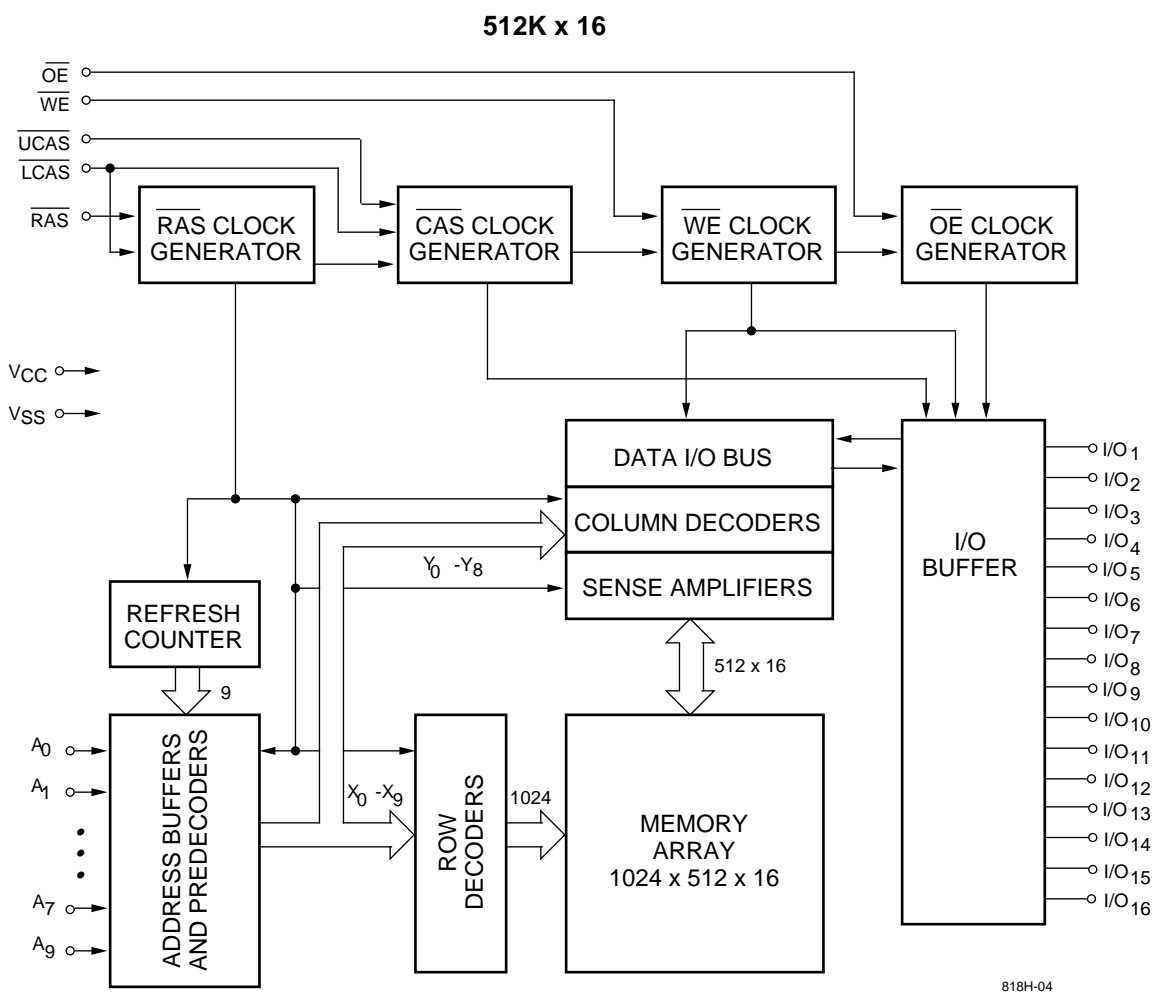
**Capacitance\***

$T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$

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

Symbol	Parameter	Access Time	V53C818H			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	30			240	mA	$t_{RC} = t_{RC}(\text{min.})$	1, 2
		35			230			
		40			220			
		45			210			
		50			200			
$I_{CC2}$	$V_{CC}$ 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	30			240	mA	$t_{RC} = t_{RC}(\text{min.})$	2
		35			230			
		40			220			
		45			210			
		50			200			
$I_{CC4}$	$V_{CC}$ Supply Current, EDO Page Mode Operation	30			230	mA	Minimum Cycle	1, 2
		35			220			
		40			210			
		45			200			
		50			190			
$I_{CC5}$	$V_{CC}$ 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				2	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		4.5	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	$I_{OL} = 4.2\text{ mA}$	
$V_{OH}$	Output High Voltage		2.4			V	$I_{OH} = -5.0\text{ mA}$	

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

AC Test conditions, input pulse levels 0 to 3V

#	Symbol	Parameter	30		35		40		45		50		Unit	Notes
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
1	$t_{RAS}$	$\overline{RAS}$ Pulse Width	30	75K	35	75K	40	75K	45	75K	50	75K	ns	
2	$t_{RC}$	Read or Write Cycle Time	65		70		75		80		90		ns	
3	$t_{RP}$	$\overline{RAS}$ Precharge Time	25		25		25		25		30		ns	
4	$t_{CSH}$	$\overline{CAS}$ Hold Time	30		35		40		45		50		ns	
5	$t_{CAS}$	$\overline{CAS}$ Pulse Width	5		6		7		8		9		ns	
6	$t_{RCD}$	$\overline{RAS}$ to $\overline{CAS}$ Delay	15	20	16	24	17	28	18	32	19	36	ns	
7	$t_{RCS}$	Read Command Setup Time	0		0		0		0		0		ns	4
8	$t_{ASR}$	Row Address Setup Time	0		0		0		0		0		ns	
9	$t_{RAH}$	Row Address Hold Time	5		6		7		8		9		ns	
10	$t_{ASC}$	Column Address Setup Time	0		0		0		0		0		ns	
11	$t_{CAH}$	Column Address Hold Time	5		5		5		6		7		ns	
12	$t_{RSH (R)}$	$\overline{RAS}$ Hold Time (Read Cycle)	10		10		10		10		10		ns	
13	$t_{CRP}$	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5		5		5		5		5		ns	
14	$t_{RCH}$	Read Command Hold Time Referenced to $\overline{CAS}$	0		0		0		0		0		ns	5
15	$t_{RRH}$	Read Command Hold Time Referenced to $\overline{RAS}$	0		0		0		0		0		ns	5
16	$t_{ROH}$	$\overline{RAS}$ Hold Time Referenced to $\overline{OE}$	6		7		8		9		10		ns	
17	$t_{OAC}$	Access Time from $\overline{OE}$		10		11		12		13		14	ns	12
18	$t_{CAC}$	Access Time from $\overline{CAS}$		10		11		12		13		14	ns	6, 7, 14
19	$t_{RAC}$	Access Time from $\overline{RAS}$		30		35		40		45		50	ns	6, 8, 9
20	$t_{CAA}$	Access Time from Column Address		16		18		20		22		24	ns	6, 7, 10
21	$t_{LZ}$	$\overline{OE}$ or $\overline{CAS}$ to Low-Z Output	0		0		0		0		0		ns	16
22	$t_{HZ}$	$\overline{OE}$ or $\overline{CAS}$ to High-Z Output	0	5	0	6	0	6	0	7	0	8	ns	16
23	$t_{AR}$	Column Address Hold Time from $\overline{RAS}$	26		28		30		35		40		ns	
24	$t_{RAD}$	$\overline{RAS}$ to Column Address Delay Time	10	14	11	17	12	20	13	23	14	26	ns	11
25	$t_{RSH (W)}$	$\overline{RAS}$ or $\overline{CAS}$ Hold Time in Write Cycle	10		10		10		10		10		ns	
26	$t_{CWL}$	Write Command to $\overline{CAS}$ Lead Time	10		11		12		13		14		ns	
27	$t_{WCS}$	Write Command Setup Time	0		0		0		0		0		ns	12, 13
28	$t_{WCH}$	Write Command Hold Time	5		5		5		6		7		ns	

**AC Characteristics** (Cont'd)

#	Symbol	Parameter	30		35		40		45		50		Unit	Notes
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
29	t <sub>WP</sub>	Write Pulse Width	5		5		5		6		7		ns	
30	t <sub>WCR</sub>	Write Command Hold Time from RAS	26		28		30		35		40		ns	
31	t <sub>RWL</sub>	Write Command to $\overline{\text{RAS}}$ Lead Time	10		11		12		13		14		ns	
32	t <sub>DS</sub>	Data in Setup Time	0		0		0		0		0		ns	14
33	t <sub>DH</sub>	Data in Hold Time	5		5		5		6		7		ns	14
34	t <sub>WOH</sub>	Write to $\overline{\text{OE}}$ Hold Time	5		5		6		7		8		ns	14
35	t <sub>OED</sub>	$\overline{\text{OE}}$ to Data Delay Time	5		5		6		7		8		ns	14
36	t <sub>RWC</sub>	Read-Modify-Write Cycle Time	100		105		110		115		130		ns	
37	t <sub>RRW</sub>	Read-Modify-Write Cycle $\overline{\text{RAS}}$ Pulse Width	65		70		75		80		87		ns	
38	t <sub>CWD</sub>	$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ Delay	26		28		30		32		34		ns	12
39	t <sub>RWD</sub>	$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ Delay in Read-Modify-Write Cycle	50		54		58		62		68		ns	12
40	t <sub>CRW</sub>	$\overline{\text{CAS}}$ Pulse Width (RMW)	44		46		48		50		52		ns	
41	t <sub>AWD</sub>	Col. Address to $\overline{\text{WE}}$ Delay	32		35		38		41		42		ns	12
42	t <sub>PC</sub>	EDO Fast Page Mode Read or Write Cycle Time	12		14		15		17		19		ns	
43	t <sub>CP</sub>	$\overline{\text{CAS}}$ Precharge Time	3		4		5		6		7		ns	
44	t <sub>CAR</sub>	Column Address to $\overline{\text{RAS}}$ Setup Time	16		18		20		22		24		ns	
45	t <sub>CAP</sub>	Access Time from Column Precharge		19		21		23		25		27	ns	7
46	t <sub>DHR</sub>	Data in Hold Time Referenced to RAS	26		28		30		35		40		ns	
47	t <sub>CSR</sub>	$\overline{\text{CAS}}$ Setup Time $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh	10		10		10		10		10		ns	
48	t <sub>RPC</sub>	$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Precharge Time	0		0		0		0		0		ns	
49	t <sub>CHR</sub>	$\overline{\text{CAS}}$ Hold Time $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh	7		8		8		10		12		ns	
50	t <sub>PCM</sub>	EDO Page Mode Read-Modify-Write Cycle Time	56		58		60		65		70		ns	
51	t <sub>COH</sub>	Output Hold After CAS Low	5		5		5		5		5		ns	
52	t <sub>OES</sub>	$\overline{\text{OE}}$ Low to $\overline{\text{CAS}}$ High Setup Time	5		5		5		5		5		ns	
53	t <sub>OEH</sub>	$\overline{\text{OE}}$ Hold Time from $\overline{\text{WE}}$ during Read-Modify Write Cycle	10		10		10		10		10		ns	

**AC Characteristics** (Cont'd)

#	Symbol	Parameter	30		35		40		45		50		Unit	Notes
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
54	$t_{OEP}$	$\overline{OE}$ High Pulse Width	10		10		10		10		10		ns	
55	$t_T$	Transition Time (Rise and Fall)	1.5	50	1.5	50	1.5	50	1.5	50	1.5	50	ns	15
56	$t_{REF}$	Refresh Interval (512 Cycles)		8		8		8		8		8	ms	17

**Notes:**

- $I_{CC}$  is dependent on output loading when the device output is selected. Specified  $I_{CC}$  (max.) is measured with the output open.
- $I_{CC}$  is dependent upon the number of address transitions. Specified  $I_{CC}$  (max.) is measured with a maximum of two transitions per address cycle in EDO Page Mode.
- 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.)  $\leq V_{CC}$ .
- $t_{RCD}$  (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  $t_{CAC}$ .
- Either  $t_{RRH}$  or  $t_{RCH}$  must be satisfied for a Read Cycle to occur.
- Measured with a load equivalent to one TTL input and 50 pF.
- Access time is determined by the longest of  $t_{CAA}$ ,  $t_{CAC}$  and  $t_{CAP}$ .
- 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.).
- 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.).
- Assumes that  $t_{RAD} \geq t_{RAD}$  (max.).
- 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  $t_{CAC}$ .
- $t_{WCS}$ ,  $t_{RWD}$ ,  $t_{AWD}$  and  $t_{CWD}$  are not restrictive operating parameters.
- $t_{WCS}$  (min.) must be satisfied in an Early Write Cycle.
- $t_{DS}$  and  $t_{DH}$  are referenced to the latter occurrence of  $\overline{CAS}$  or  $\overline{WE}$ .
- $t_T$  is measured between  $V_{IH}$  (min.) and  $V_{IL}$  (max.). AC-measurements assume  $t_T = 3$  ns.
- Assumes a three-state test load (5 pF and a 380 Ohm Thevenin equivalent).
- 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.

**Truth Table**

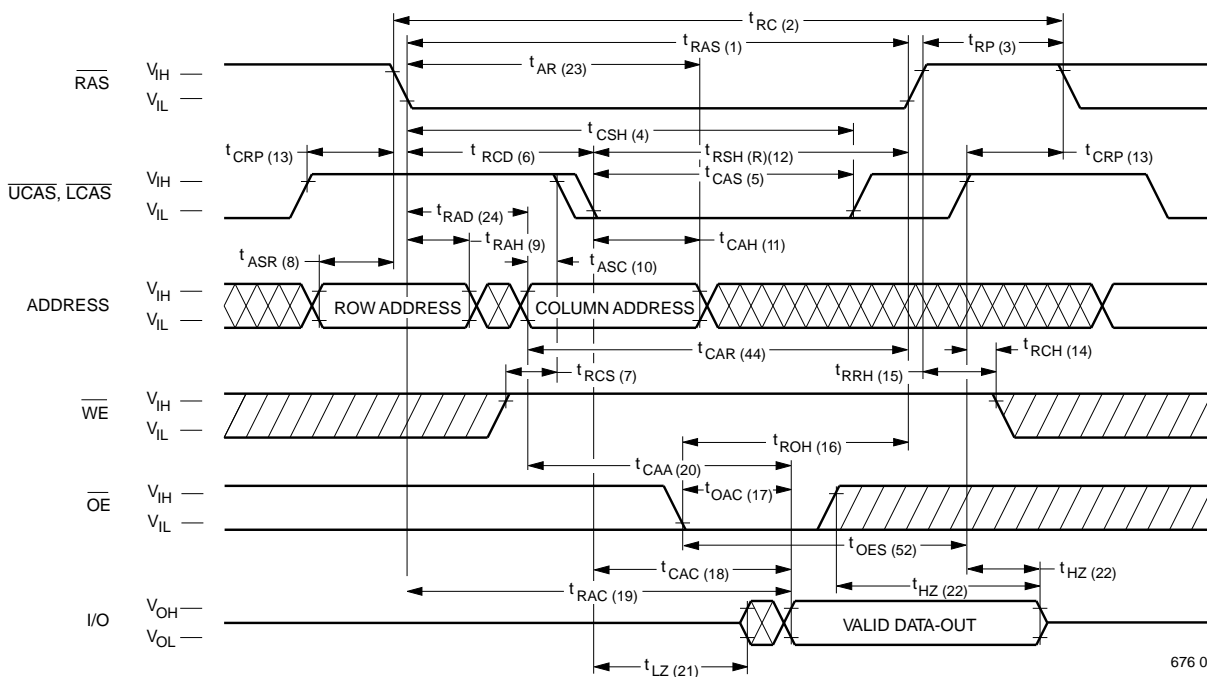
Function	RAS	LCAS	UCAS	WE	OE	ADDRESS	I/O	Notes
Standby	H	H	H	X	X	X	High-Z	
Read: Word	L	L	L	H	L	ROW/COL	Data Out	
Read: Lower Byte	L	L	H	H	L	ROW/COL	Lower Byte, Data-Out Upper Byte, High-Z	
Read: Upper Byte	L	H	L	H	L	ROW/COL	Lower Byte, High-Z Upper Byte, Data-Out	
Write: Word (Early-Write)	L	L	L	L	X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

**Notes:**

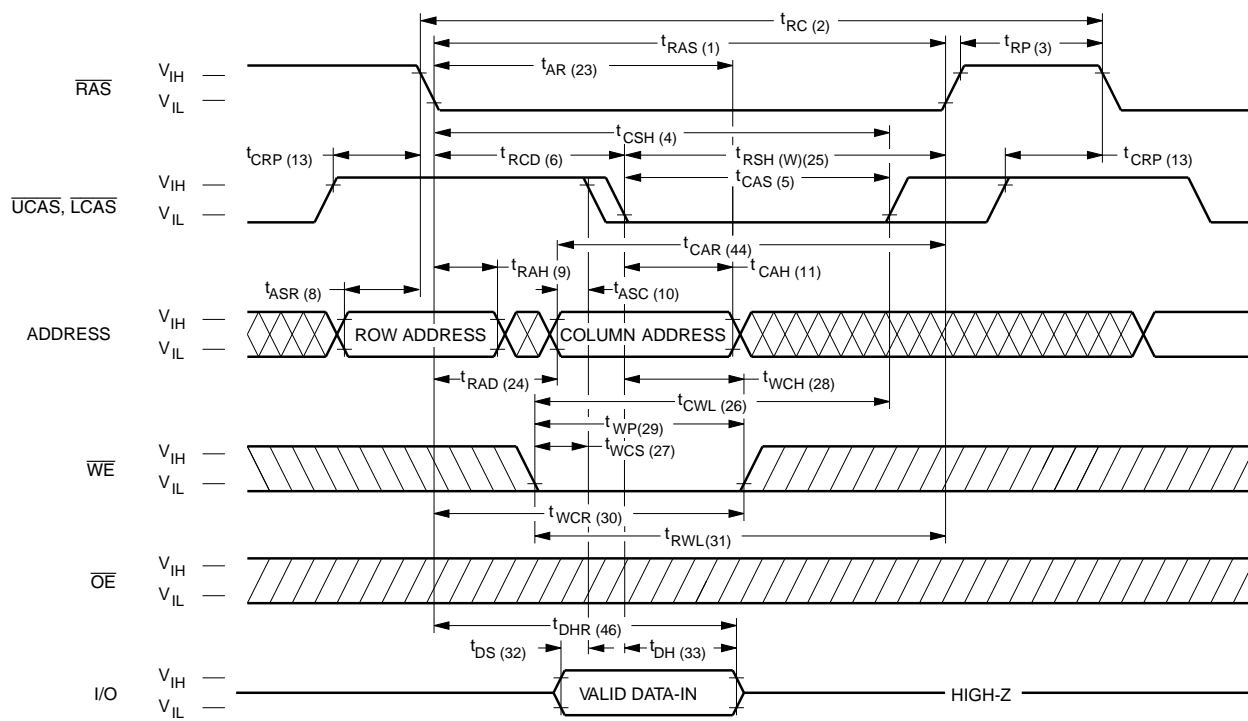
1. Byte Write cycles  $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$  active.
2. Byte Read cycles  $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$  active.
3. Only one of the two  $\overline{\text{CAS}}$  must be active ( $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$ ).



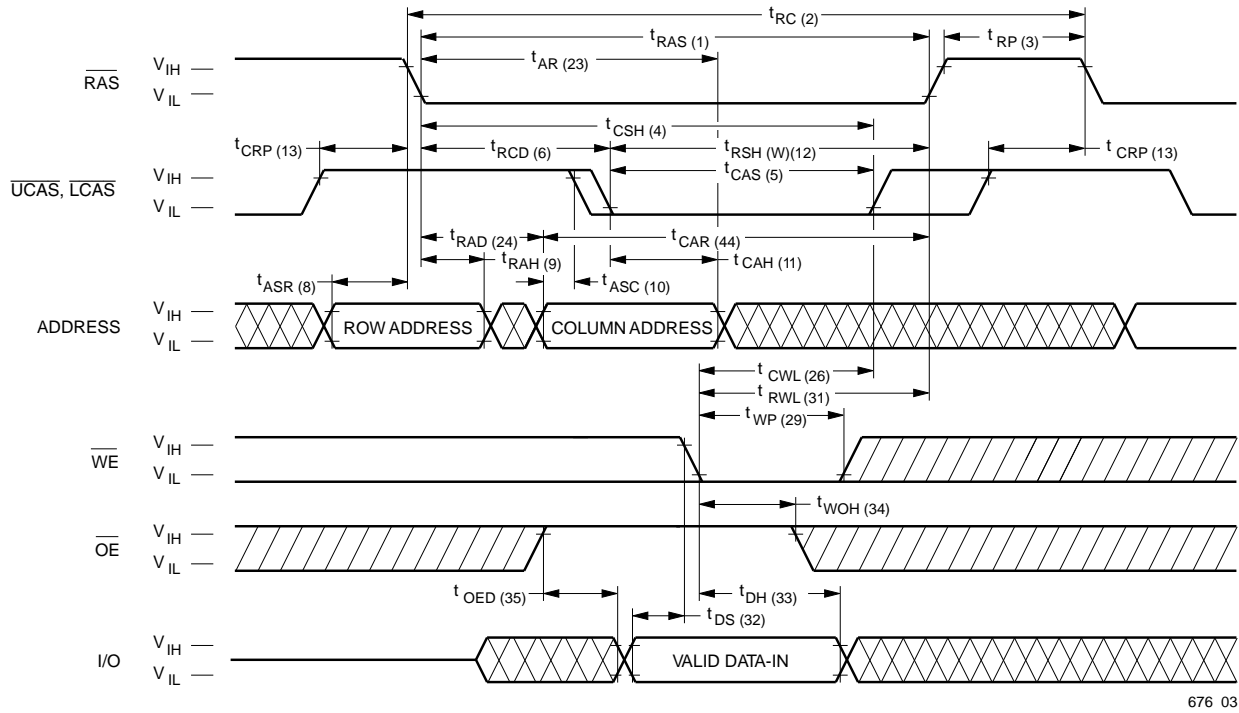
**Waveforms of Read Cycle**



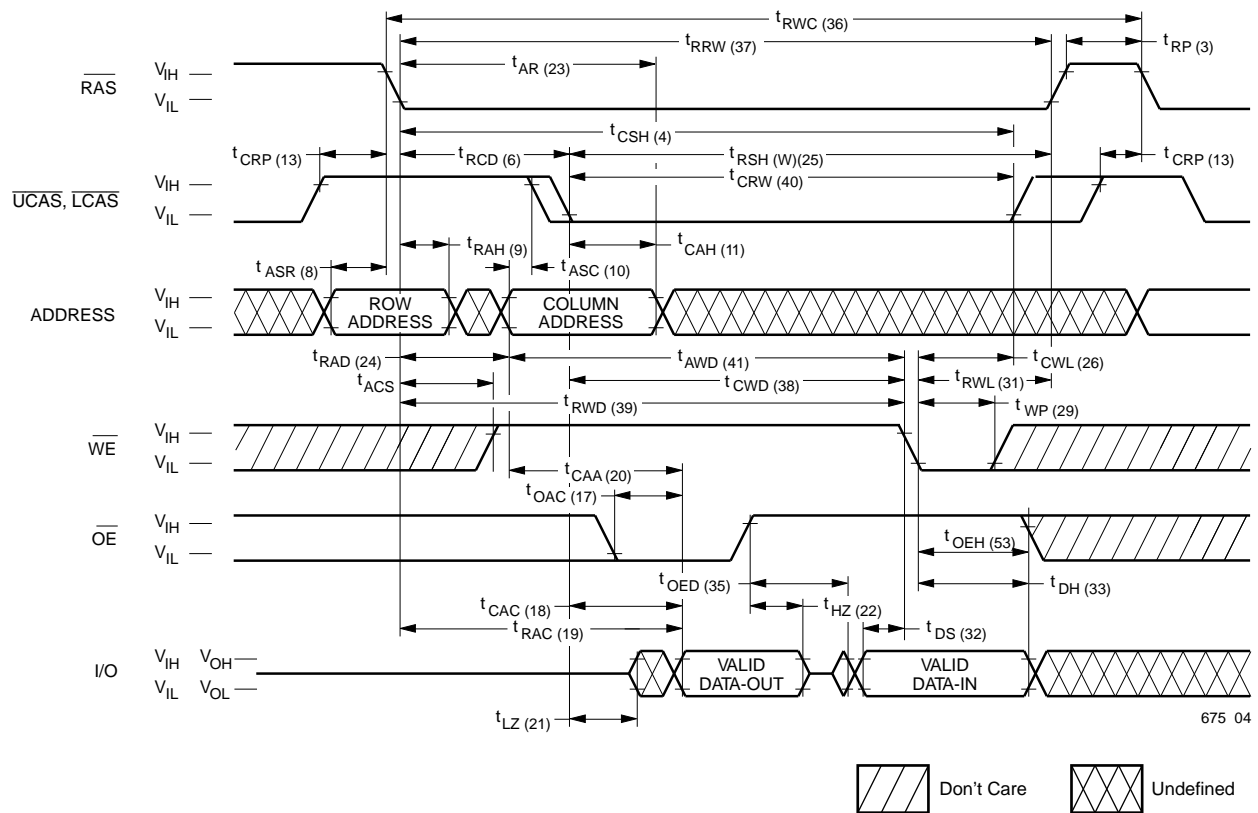
**Waveforms of Early Write Cycle**



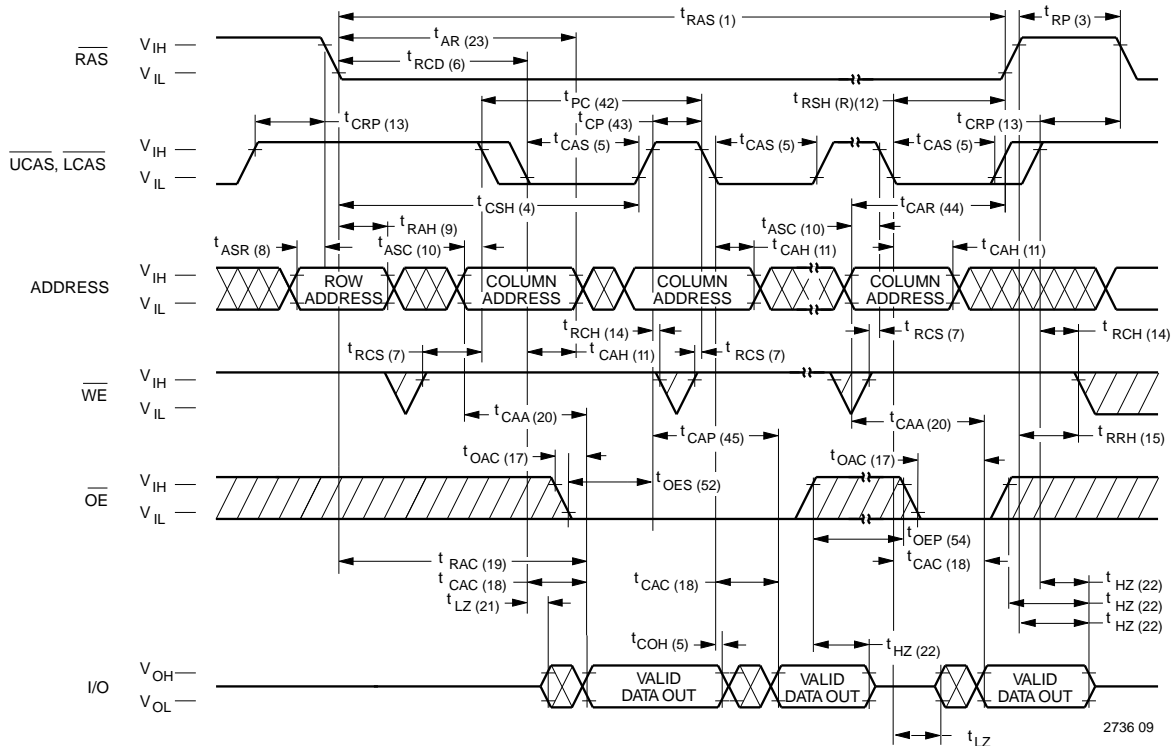
Waveforms of OE-Controlled Write Cycle



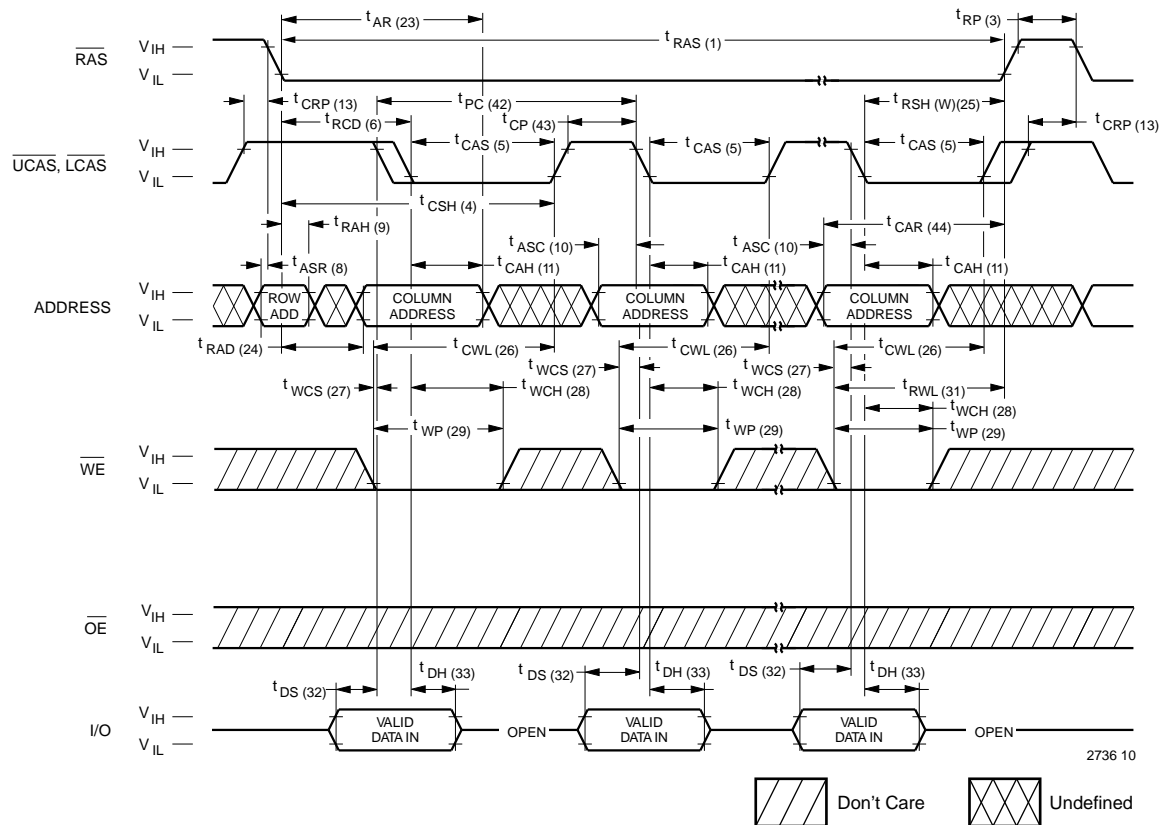
Waveforms of Read-Modify-Write Cycle



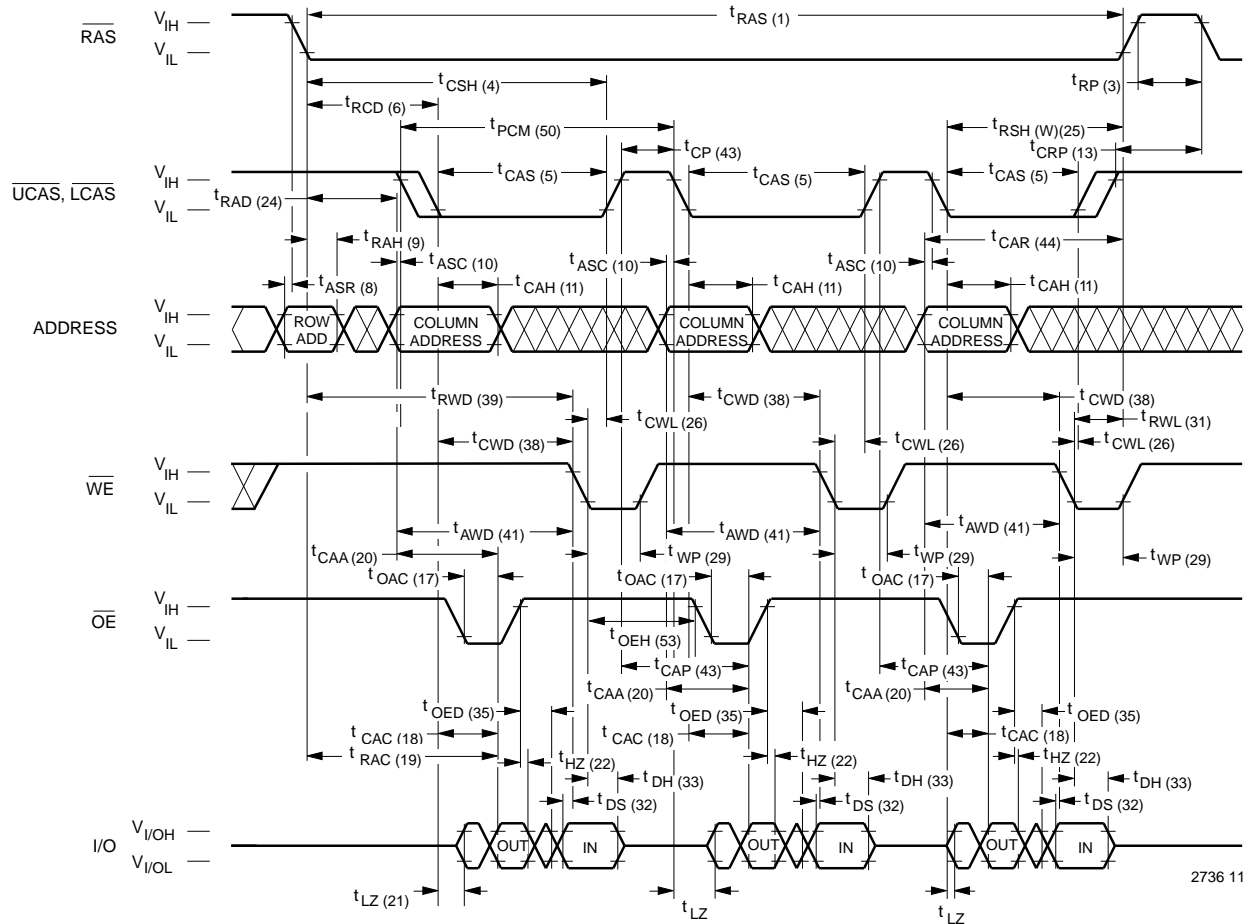
Waveforms of EDO Page Mode Read Cycle



Waveforms of EDO Page Mode Write Cycle

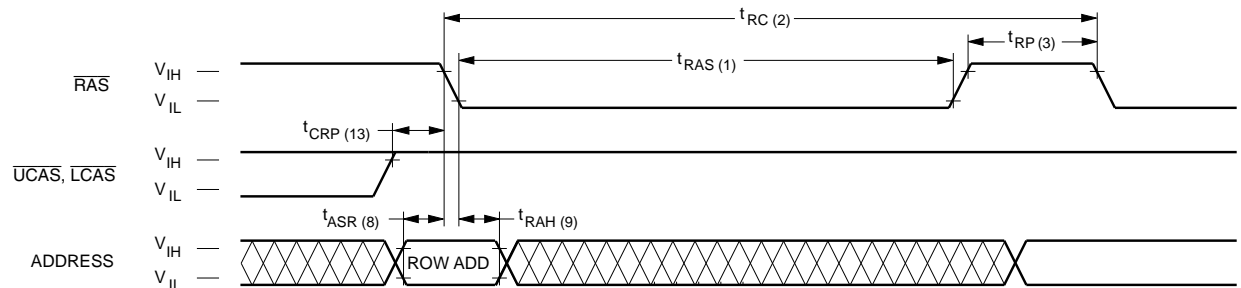


Waveforms of EDO Page Mode Read-Write Cycle



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Waveforms of RAS-Only Refresh Cycle

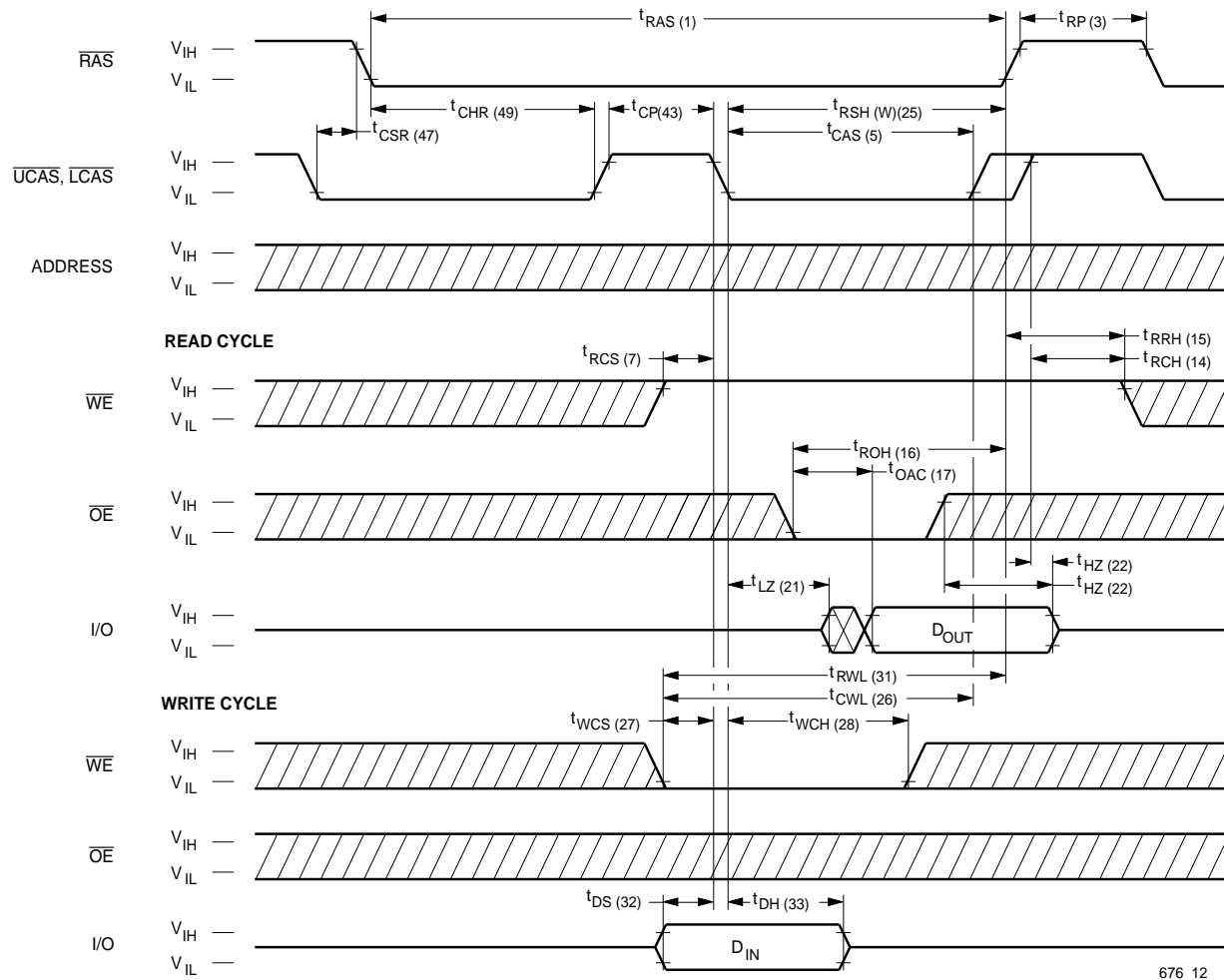


2736 12

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

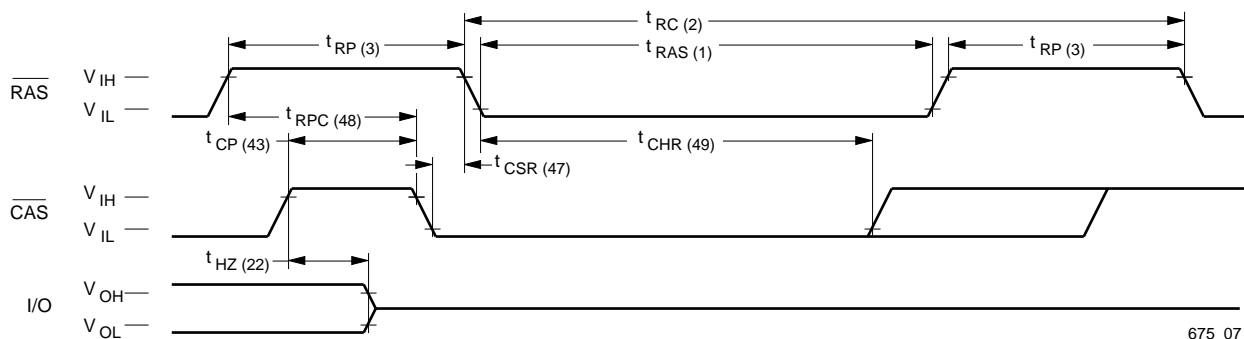


**Waveforms of  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  Refresh Counter Test Cycle**



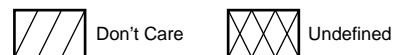
676 12

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

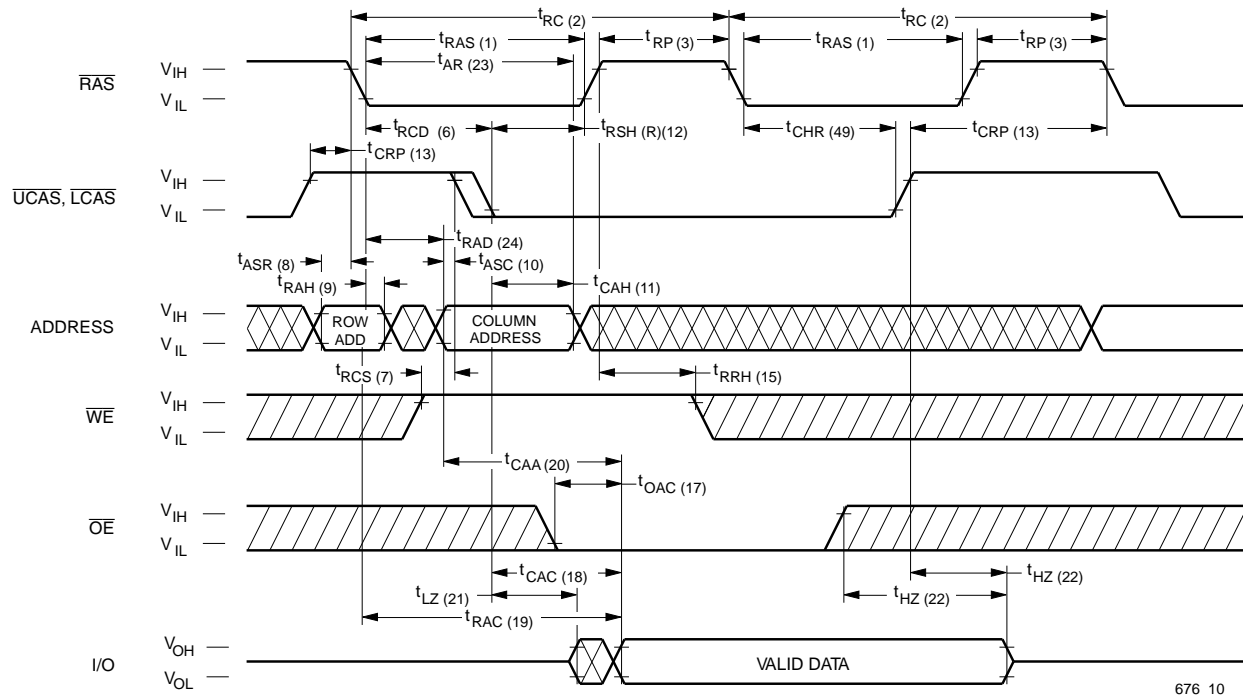


675 07

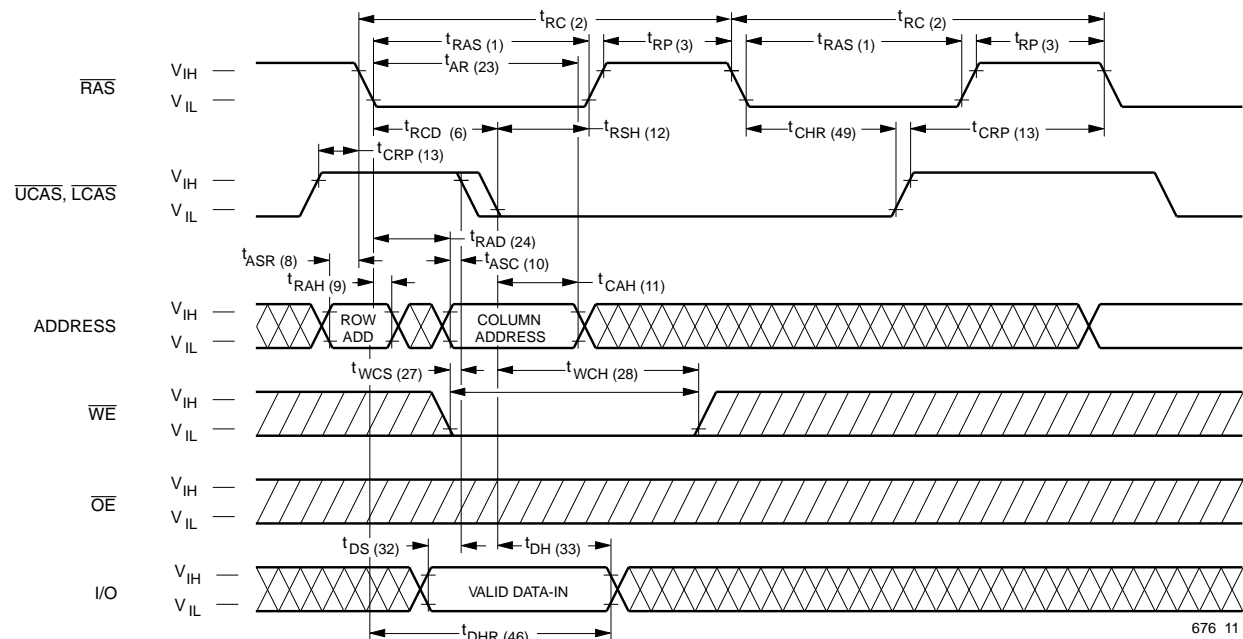
NOTE:  $\overline{\text{WE}}$ ,  $\overline{\text{OE}}$ ,  $A_0$ - $A_8$  = Don't care



Waveforms of Hidden Refresh Cycle (Read)



Waveforms of Hidden Refresh Cycle (Write)



Don't Care Undefined



**Extended Data Output Page Mode**

EDO Page operation permits all 512 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 83 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:

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

**Data Output Operation**

The V53C818H 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  $\mu s$  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 V53C818H 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.

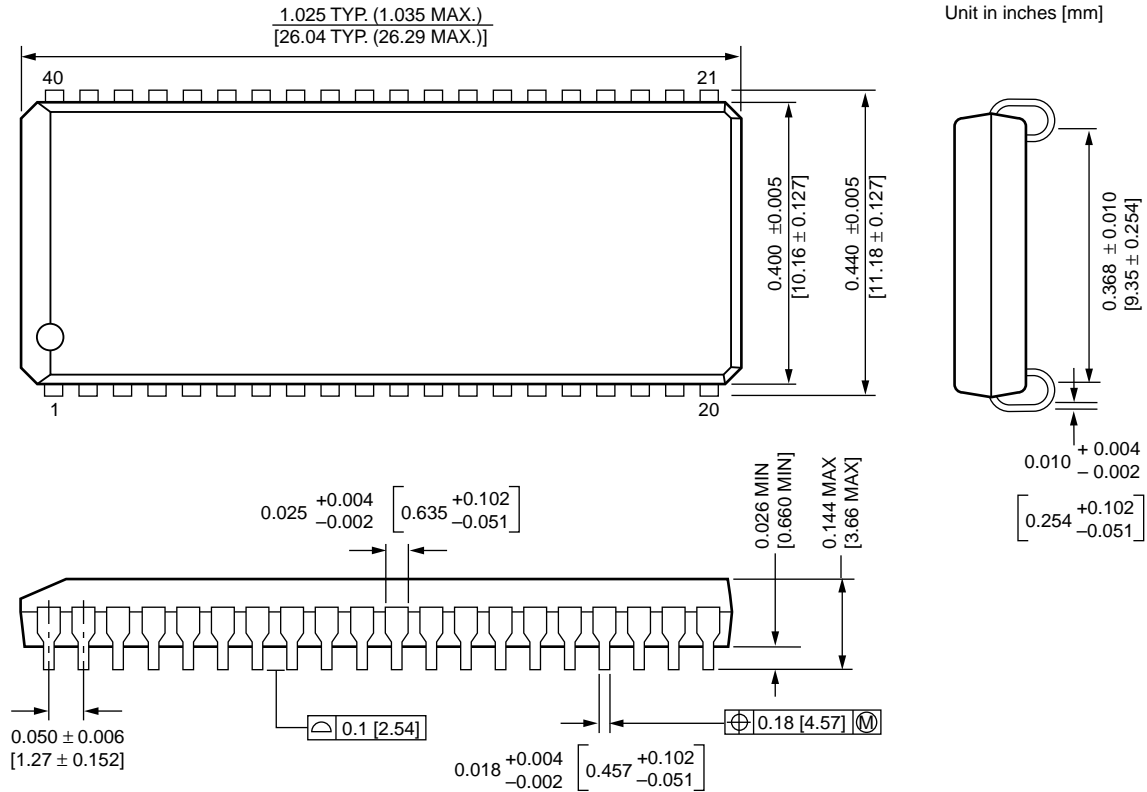
**Table 1. V53C818H Data Output Operation for Various Cycle Types**

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

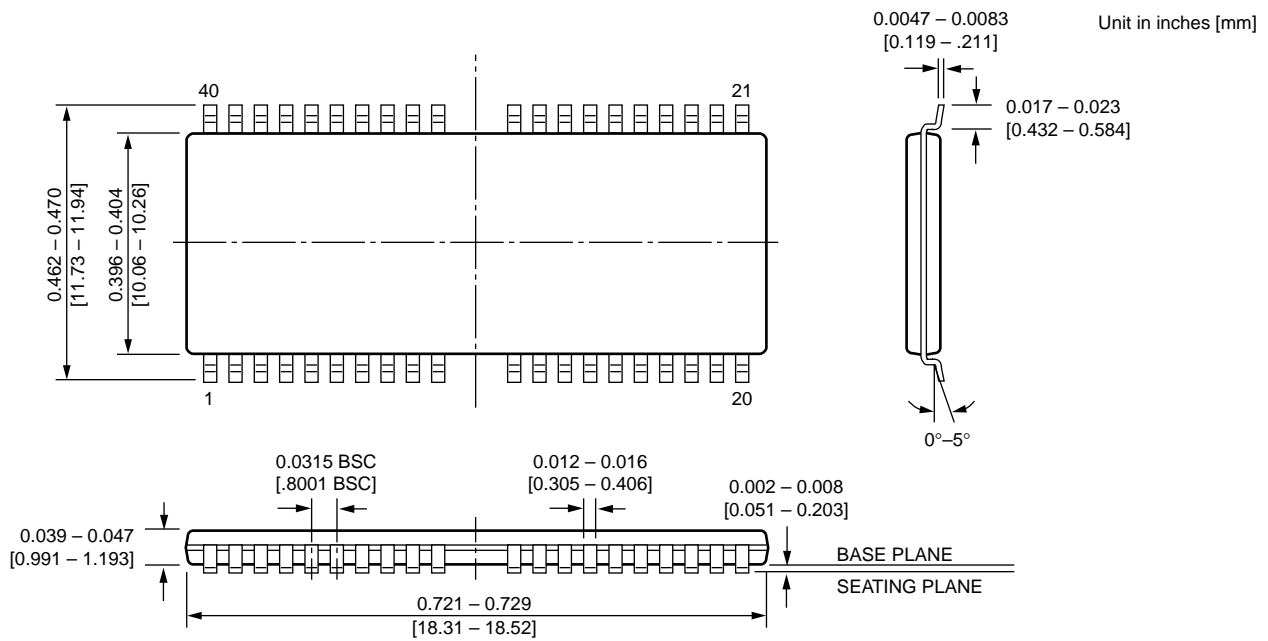


**Package Diagrams**

**40-Pin Plastic SOJ**



**40/44L-Pin TSOP-II**



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