

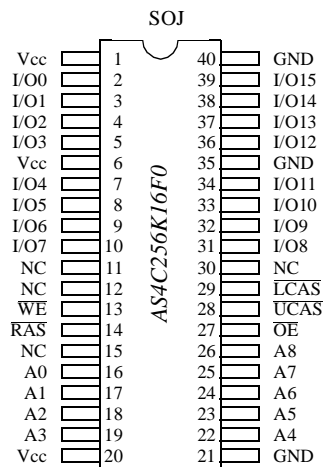
High Speed 256K×16 CMOS DRAM (Fast Page Mode)

PRELIMINARY

FEATURES

- Organization: 262,144 words by 16 bits
- High speed
 - 50/60 ns $\overline{\text{RAS}}$ access time
 - 25/30 ns column address access time
 - 14/15 ns $\overline{\text{CAS}}$ access time
- Low power consumption
 - Active: 715 mW max (4C256K16F0-50)
 - Standby: 5.5 mW max, CMOS I/O
- Fast page mode
- 512 refresh cycles, 8 ms refresh interval
 - $\overline{\text{RAS}}$ -only or $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh
- Read-modify-write
- TTL-compatible, three-state I/O
- JEDEC standard packages
 - 400 mil, 40-pin SOJ
- Single 5V power supply / built-in V_{bb} generator

PIN ARRANGEMENT



PIN DESIGNATION

Pin(s)	Description
A0 to A8	Address Inputs
$\overline{\text{RAS}}$	Row Address Strobe
I/O0 to I/O15	Input/Output
$\overline{\text{OE}}$	Output Enable
$\overline{\text{UCAS}}$	Column Address Strobe, Upper Byte
$\overline{\text{LCAS}}$	Column Address Strobe, Lower Byte
$\overline{\text{WE}}$	Read/Write Control
V_{CC}	Power (+5V \pm 10%)
GND	Ground

SELECTION GUIDE

	Symbol	4C256K16F0-50	4C256K16F0-60	Unit
Maximum $\overline{\text{RAS}}$ Access Time	t_{RAC}	50	60	ns
Maximum Column Address Access Time	t_{AA}	25	30	ns
Maximum $\overline{\text{CAS}}$ Access Time	t_{CAC}	14	15	ns
Maximum Output Enable ($\overline{\text{OE}}$) Access Time	t_{OEA}	14	15	ns
Minimum Read or Write Cycle Time	t_{RC}	85	110	ns
Minimum Fast Page Mode Cycle Time	t_{PC}	30	35	ns
Maximum Operating Current	I_{CC1}	130	110	mA
Maximum CMOS Standby Current	I_{CC5}	1.0	1.0	mA



FUNCTIONAL DESCRIPTION

The AS4C256K16F0 is a high performance 4 megabit CMOS Dynamic Random Access Memory (DRAM) organized as 262,144 words by 16 bits. The AS4C256K16F0 is fabricated with advanced CMOS technology and designed with innovative design techniques resulting in high speed, extremely low power and wide operating margins at component and system levels.

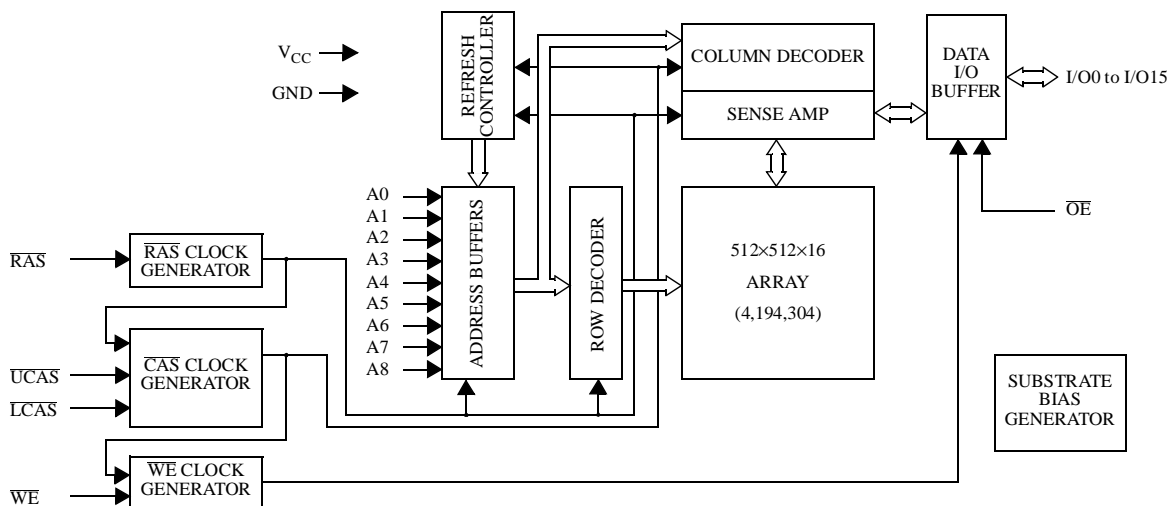
The AS4C256K16F0 features a high speed page mode operation in which high speed read, write and read-write are performed on any of the 512×16 bits defined by the column address. The asynchronous column address uses an extremely short row address capture time to ease the system level timing constraints associated with multiplexed addressing. Output is tri-stated by a column address strobe ($\overline{\text{CAS}}$) which acts as an output enable independent of $\overline{\text{RAS}}$. Very fast $\overline{\text{CAS}}$ to output access time eases system design.

Refresh on the 512 address combinations of A0 to A8 during an 8 ms period is accomplished by performing any of the following:

- $\overline{\text{RAS}}$ -only refresh cycles
- Hidden refresh cycles
- $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh cycles
- Normal read or write cycles

The AS4C256K16F0 is available in a standard 40-pin plastic SOJ packages compatible with widely available automated testing and insertion equipment. System level features include single power supply of $5\text{V} \pm 10\%$ tolerance and direct interface with TTL logic families.

LOGIC BLOCK DIAGRAM



RECOMMENDED OPERATING CONDITIONS

($T_a = 0^\circ\text{C}$ to $+70^\circ\text{C}$)

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
	GND	0.0	0.0	0.0	V
Input Voltage	V_{IH}	2.4	—	V_{CC}	V
	V_{IL}	-0.5^\dagger	—	0.8	V

$^\dagger V_{IL}$ min -3.0V for pulse widths less than 5 ns.



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Input Voltage	V_{in}	-1.0	+7.0	V
Input Voltage (I/Os)	$V_{I/O}$	-1.0	$V_{CC} + 0.5$	V
Power Supply Voltage	V_{CC}	-1.0	+7.0	V
Operating Temperature	T_{OPR}	0	+70	°C
Storage Temperature (Plastic)	T_{STG}	-55	+150	°C
Soldering Temperature × Time	T_{SOLDER}	–	260×10	°C × sec
Power Dissipation	P_D	–	1	W
Short Circuit Output Current	I_{out}	–	50	mA

NOTE: Stresses greater than those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

DC ELECTRICAL CHARACTERISTICS

($V_{CC} = 5 \pm 10\%$, GND = 0V, $T_a = 0^\circ\text{C}$ to $+70^\circ\text{C}$)

Parameter	Symbol	Test Conditions	-50		-60		Unit	Notes
			Min	Max	Min	Max		
Input Leakage Current	I_{IL}	$0V \leq V_{in} \leq +5.5V$ Pins Not Under Test = 0V	-10.0	+10.0	-10.0	+10.0	μA	
Output Leakage Current	I_{OL}	D_{OUT} Disabled, $0V \leq V_{out} \leq +5.5V$	-10.0	+10.0	-10.0	+10.0	μA	
Operating Power Supply Current	I_{CC1}	RAS, UCAS, LCAS, Address Cycling; $t_{RC} = \min$	–	130	–	110	mA	1,2
TTL Standby Power Supply Current	I_{CC2}	$\overline{RAS} = \overline{UCAS} = \overline{LCAS} = V_{IH}$	–	2.0	–	2.0	mA	
Average Power Supply Current, RAS Refresh Mode	I_{CC3}	RAS Cycling, $\overline{UCAS} = \overline{LCAS} = V_{IH}$, $t_{RC} = \min$	–	130	–	110	mA	1
Fast Page Mode Average Power Supply Current	I_{CC4}	$RAS = V_{IL}$, $\overline{UCAS} = \overline{LCAS}$, Address Cycling; $t_{PC} = \min$	–	70	–	65	mA	1,2
CMOS Standby Power Supply Current	I_{CC5}	$\overline{RAS} = \overline{UCAS} = \overline{LCAS} = V_{CC} - 0.2V$	–	1.0	–	1.0	mA	
CAS-before-RAS Refresh Power Supply Current	I_{CC6}	RAS, UCAS, LCAS, Cycling; $t_{RC} = \min$	–	130	–	110	mA	1
Output Voltage	V_{OH}	$I_{OUT} = -5.0 \text{ mA}$	2.4	–	2.4	–	V	
	V_{OL}	$I_{OUT} = 4.2 \text{ mA}$	–	0.4	–	0.4	V	

Shaded areas contain advance information.

**AC PARAMETERS COMMON TO ALL WAVEFORMS**(V_{CC} = 5V±10%, GND = 0V, T_a = 0°C to +70°C)

Std Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t _{RPC}	RAS Precharge to $\overline{\text{CAS}}$ Hold Time	5	–	5	–	ns	
t _{RC}	Random Read or Write Cycle Time	85	–	110	–	ns	
t _{RP}	$\overline{\text{RAS}}$ Precharge Time	30	–	40	–	ns	
t _{RAS}	RAS Pulse Width	50	10K	60	10K	ns	
t _{CAS}	$\overline{\text{CAS}}$ Pulse Width	8	10K	12	10K	ns	
t _{RCD}	RAS to $\overline{\text{CAS}}$ Delay Time	15	35	20	45	ns	6
t _{RAD}	$\overline{\text{RAS}}$ to Column Address Delay Time	15	25	15	30	ns	7
t _{RSH}	$\overline{\text{CAS}}$ to RAS Hold Time	10	–	15	–	ns	
t _{CSH}	RAS to $\overline{\text{CAS}}$ Hold Time	50	–	60	–	ns	
t _{CRP}	$\overline{\text{CAS}}$ to RAS Precharge Time	5	–	5	–	ns	
t _{ASR}	Row Address Setup Time	0	–	0	–	ns	
t _{RAH}	Row Address Hold Time	9	–	10	–	ns	
t _T	Transition Time (Rise and Fall)	3	50	3	50	ns	4,5
t _{REF}	Refresh Period	–	8	–	8	ms	3
t _{RAL}	Column Address to $\overline{\text{RAS}}$ Lead Time	25	–	30	–	ns	
t _{CP}	$\overline{\text{CAS}}$ Precharge Time	9	–	10	–	ns	

Shaded areas contain advance information.

READ CYCLE(V_{CC} = 5V±10%, GND = 0V, T_a = 0°C to +70°C)

Std Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t _{RAC}	Access Time from RAS	–	50	–	60	ns	6
t _{CAC}	Access Time from $\overline{\text{CAS}}$	–	14	–	15	ns	6,13
t _{AA}	Access Time from Address	–	25	–	30	ns	7,13
t _{AR}	Column Add Hold from $\overline{\text{RAS}}$	30	–	40	–	ns	
t _{RCS}	Read Command Setup Time	0	–	0	–	ns	
t _{RCH}	Read Command Hold Time to $\overline{\text{CAS}}$	0	–	0	–	ns	9
t _{RRH}	Read Command Hold Time to RAS	0	–	0	–	ns	9
t _{OFF}	Output Buffer Turn-Off Time	0	13	0	15	ns	8,10

Shaded areas contain advance information.

**WRITE CYCLE**(V_{CC} = 5V±10%, GND = 0V, T_a = 0°C to +70°C)

Std Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t _{ASC}	Column Address Setup Time	0	–	0	–	ns	
t _{CAH}	Column Address Hold Time	9	–	10	–	ns	
t _{WCS}	Write Command Setup Time	0	–	0	–	ns	11
t _{WCH}	Write Command Hold Time	9	–	10	–	ns	11
t _{WP}	Write Command Pulse Width	9	–	10	–	ns	
t _{RWL}	Write Command to $\overline{\text{RAS}}$ Lead Time	12	–	15	–	ns	
t _{CWL}	Write Command to $\overline{\text{CAS}}$ Lead Time	11	–	15	–	ns	
t _{DS}	Data-In Setup Time	0	–	0	–	ns	12
t _{DH}	Data-In Hold Time	9	–	10	–	ns	12

Shaded areas contain advance information.

READ-MODIFY-WRITE CYCLE(V_{CC} = 5V±10%, GND = 0V, T_a = 0°C to +70°C)

Std Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t _{RWC}	Read-Write Cycle Time	130	–	150	–	ns	
t _{RWD}	$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ Delay Time	70	–	80	–	ns	11
t _{CWD}	$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ Delay Time	35	–	40	–	ns	11
t _{AWD}	Column Address to $\overline{\text{WE}}$ Delay Time	50	–	55	–	ns	11

Shaded areas contain advance information.

**FAST PAGE MODE CYCLE**(V_{CC} = 5V±10%, GND = 0V, T_a = 0°C to +70°C)

Std Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t _{PC}	Read or Write Cycle Time (Fast Page)	30	–	35	–	ns	14
t _{CPA}	Access Time from $\overline{\text{CAS}}$ Precharge	–	30	–	35	ns	13
t _{CP}	$\overline{\text{CAS}}$ Precharge Time (Fast Page)	9	–	10	–	ns	
t _{PRWC}	Fast Page Mode RMW Cycle	70	–	80	–	ns	
t _{CRW}	Page Mode $\overline{\text{CAS}}$ Pulse Width (RMW)	50	–	50	–	ns	
t _{RASP}	RAS Pulse Width	50	100K	60	100K	ns	

Shaded areas contain advance information.

REFRESH CYCLE(V_{CC} = 5V±10%, GND = 0V, T_a = 0°C to +70°C)

Std Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t _{CSR}	$\overline{\text{CAS}}$ Setup Time ($\overline{\text{CAS}}$ -before-RAS)	5	–	5	–	ns	3
t _{CHR}	$\overline{\text{CAS}}$ Hold Time ($\overline{\text{CAS}}$ -before-RAS)	10	–	10	–	ns	3
t _{RPC}	RAS Precharge to $\overline{\text{CAS}}$ Hold Time	5	–	5	–	ns	
t _{CPT}	$\overline{\text{CAS}}$ Precharge Time ($\overline{\text{CAS}}$ -before-RAS Counter Test)	10		10		ns	

Shaded areas contain advance information.

OUTPUT ENABLE(V_{CC} = 5V±10%, GND = 0V, T_a = 0°C to +70°C)

Std Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t _{CLZ}	$\overline{\text{CAS}}$ to Output in Low Z	3	–	3	–	ns	8
t _{ROH}	RAS Hold Time Referenced to $\overline{\text{OE}}$	9	–	10	–	ns	
t _{OEA}	$\overline{\text{OE}}$ Access Time	–	14	–	15	ns	
t _{OED}	$\overline{\text{OE}}$ to Data Delay	14	–	15	–	ns	
t _{OEZ}	Output Buffer Turnoff Delay from $\overline{\text{OE}}$	–	14	–	15	ns	8
t _{OEH}	$\overline{\text{OE}}$ Command Hold Time	10	–	10	–	ns	

Shaded areas contain advance information.



NOTES

1. I_{CC1} , I_{CC3} , I_{CC4} , and I_{CC6} depend on cycle rate.
2. I_{CC1} and I_{CC4} depend on output loading. Specified values are obtained with the output open.
3. An initial pause of 200 μ s is required after power-up followed by any 8 \overline{RAS} cycles before proper device operation is achieved. In the case of an internal refresh counter, a minimum of 8 \overline{CAS} -before- \overline{RAS} initialization cycles instead of 8 \overline{RAS} cycles are required. 8 initialization cycles are required after extended periods of bias without clocks (greater than 8 ms).
4. AC Characteristics assume $t_T = 5$ ns. All AC parameters are measured with a load equivalent to two TTL loads and 100 pF, $V_{IL}(\min) \geq GND$ and $V_{IH}(\max) \leq V_{CC}$.
5. $V_{IH}(\min)$ and $V_{IL}(\max)$ are reference levels for measuring timing of input signals. Transition times are measured between V_{IH} and V_{IL} .
6. Operation within the $t_{RCD}(\max)$ limit insures that $t_{RAC}(\max)$ can be met. $t_{RCD}(\max)$ is specified as a reference point only. If t_{RCD} is greater than the specified $t_{RCD}(\max)$ limit, then access time is controlled exclusively by t_{CAC} .
7. Operation within the $t_{RAD}(\max)$ limit insures that $t_{RAC}(\max)$ can be met. $t_{RAD}(\max)$ is specified as a reference point only. If t_{RAD} is greater than the specified $t_{RAD}(\max)$ limit, then access time is controlled exclusively by t_{AA} .
8. Assumes three state test load (5 pF and a 380 Ω Thevenin equivalent).
9. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
10. $t_{OFF}(\max)$ defines the time at which the output achieves the open circuit condition; it is not referenced to output voltage levels.
11. t_{WCS} , t_{WCH} , t_{RWD} , t_{CWD} and t_{AWD} are not restrictive operating parameters. They are included in the datasheet as electrical characteristics only. If $t_{WS} \geq t_{WS}(\min)$ and $t_{WH} \geq t_{WH}(\min)$, the cycle is an early write cycle and data out pins will remain open circuit, high impedance, throughout the cycle. If $t_{RWD} \geq t_{RWD}(\min)$, $t_{CWD} \geq t_{CWD}(\min)$ and $t_{AWD} \geq t_{AWD}(\min)$, the cycle is a read-write cycle and the data out will contain data read from the selected cell. If neither of the above conditions is satisfied, the condition of the data out at access time is indeterminate.
12. These parameters are referenced to \overline{CAS} leading edge in early write cycles and to \overline{WE} leading edge in read-write cycles.
13. Access time is determined by the longest of t_{CAA} or t_{CAC} or t_{CPA} .
14. $t_{ASC} \geq t_{CP}$ to achieve $t_{PC}(\min)$ and $t_{CPA}(\max)$ values.
15. These parameters are sampled and not 100% tested.

KEY TO SWITCHING WAVEFORMS



Don't Care Input



Rising Input



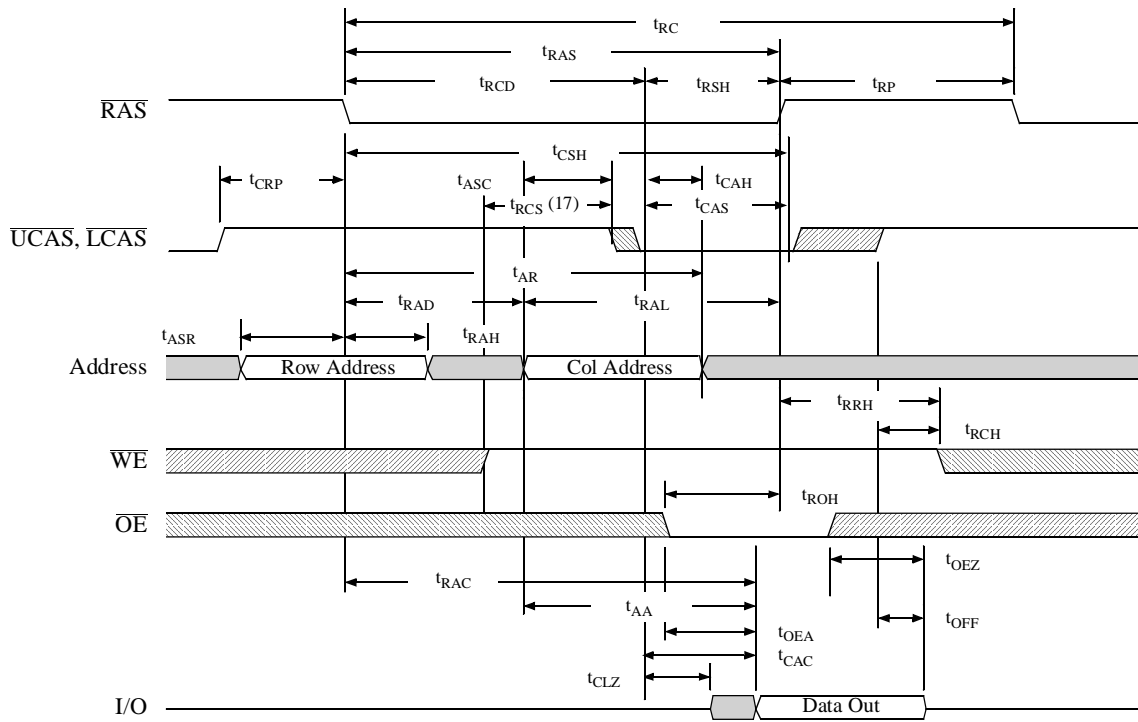
Falling Input



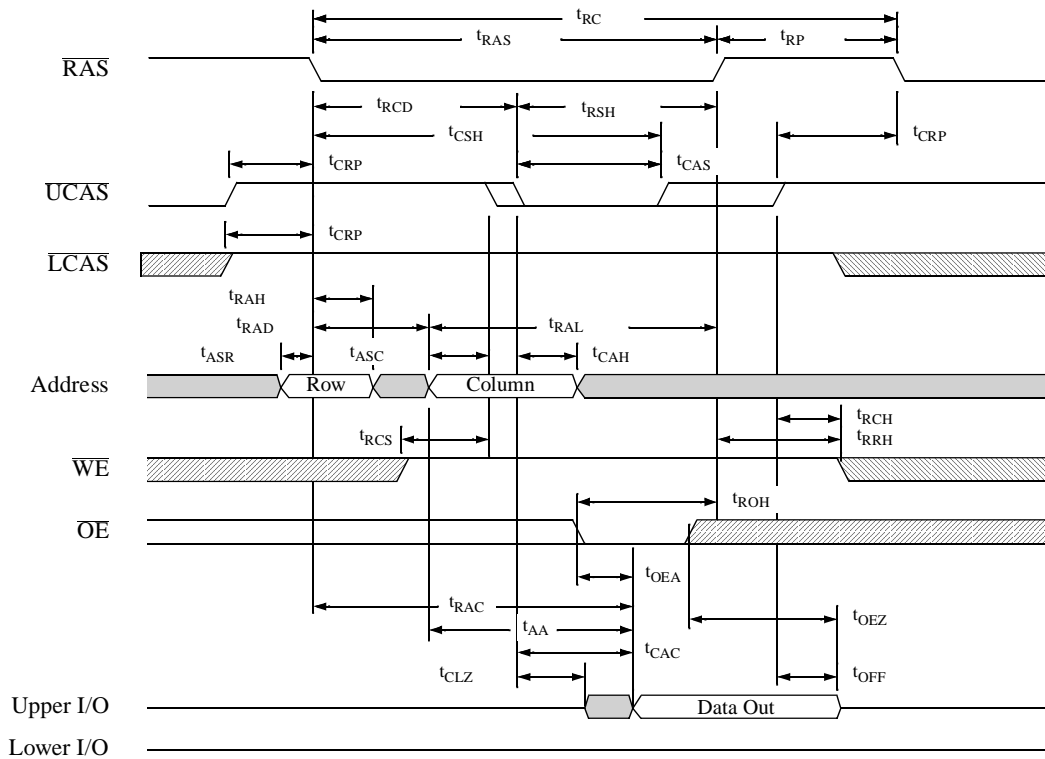
Undefined Output



TIMING WAVEFORM OF READ CYCLE



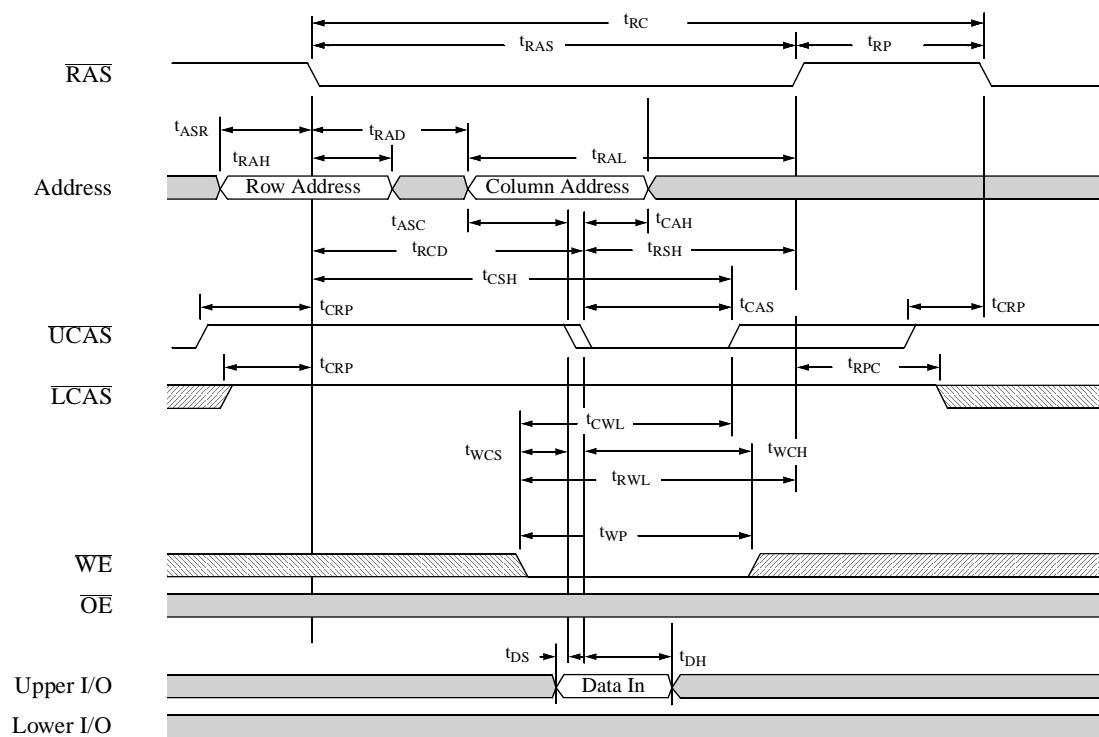
TIMING WAVEFORM OF UPPER BYTE READ CYCLE



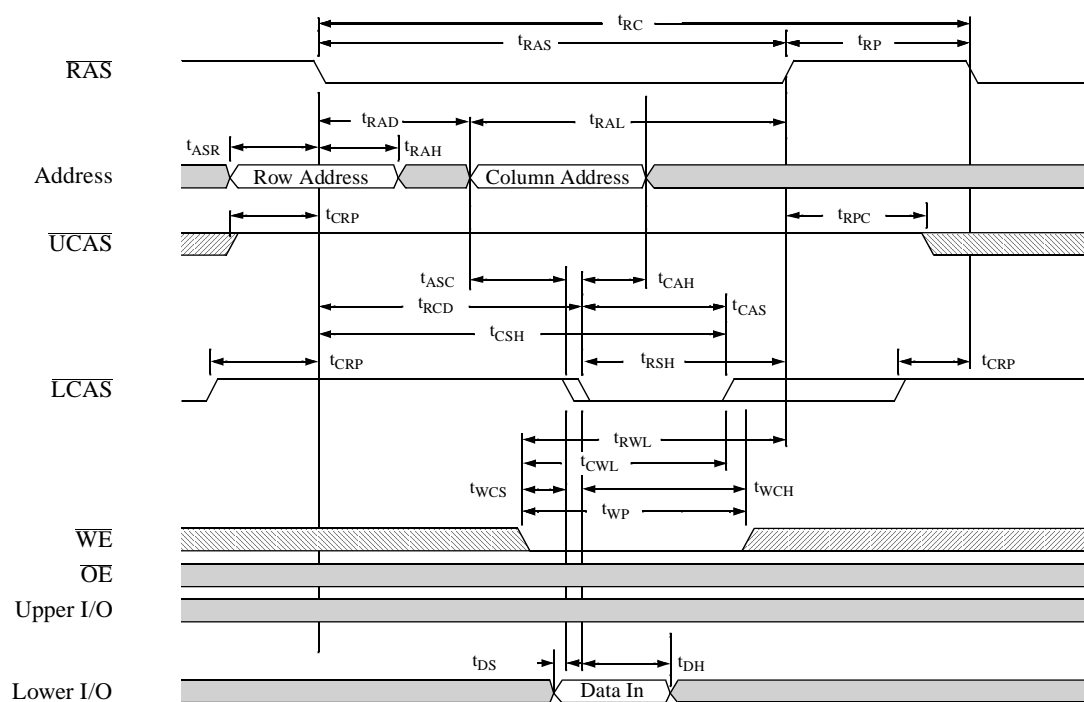




TIMING WAVEFORM OF UPPER BYTE EARLY WRITE CYCLE



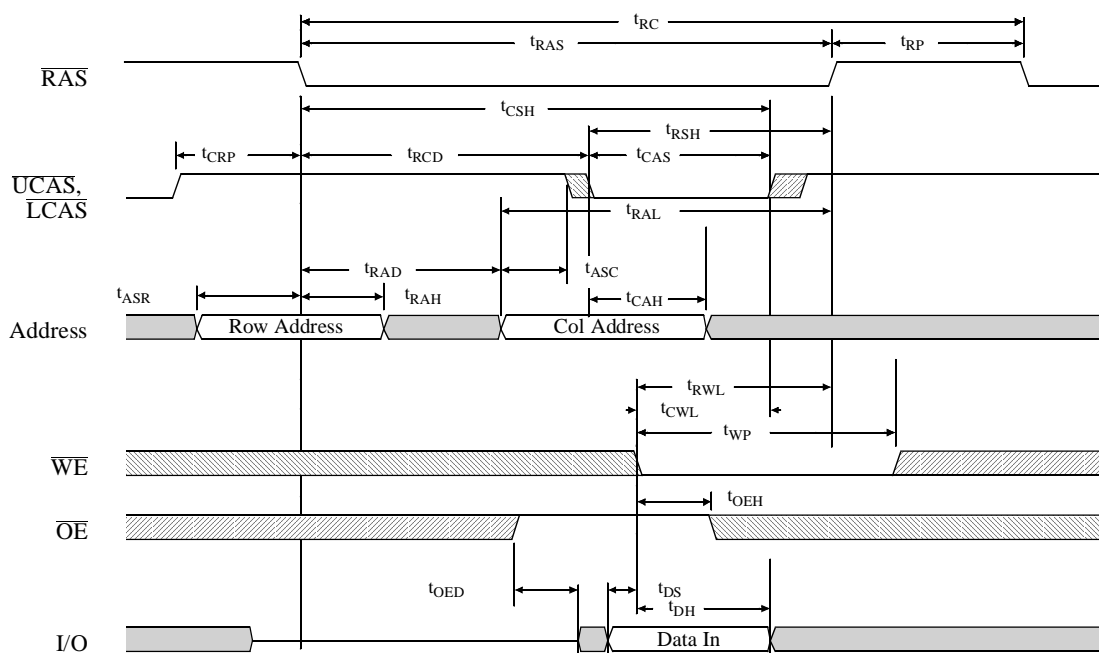
TIMING WAVEFORM OF LOWER BYTE EARLY WRITE CYCLE





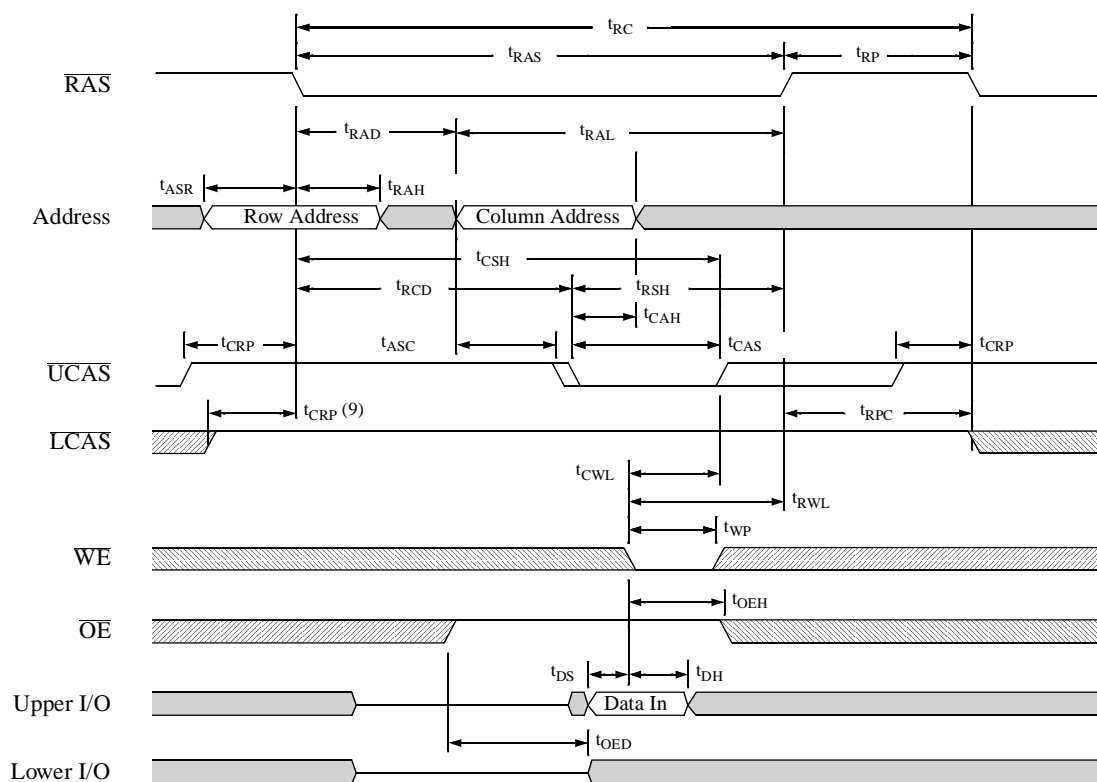
TIMING WAVEFORM OF WRITE CYCLE

(OE Controlled)



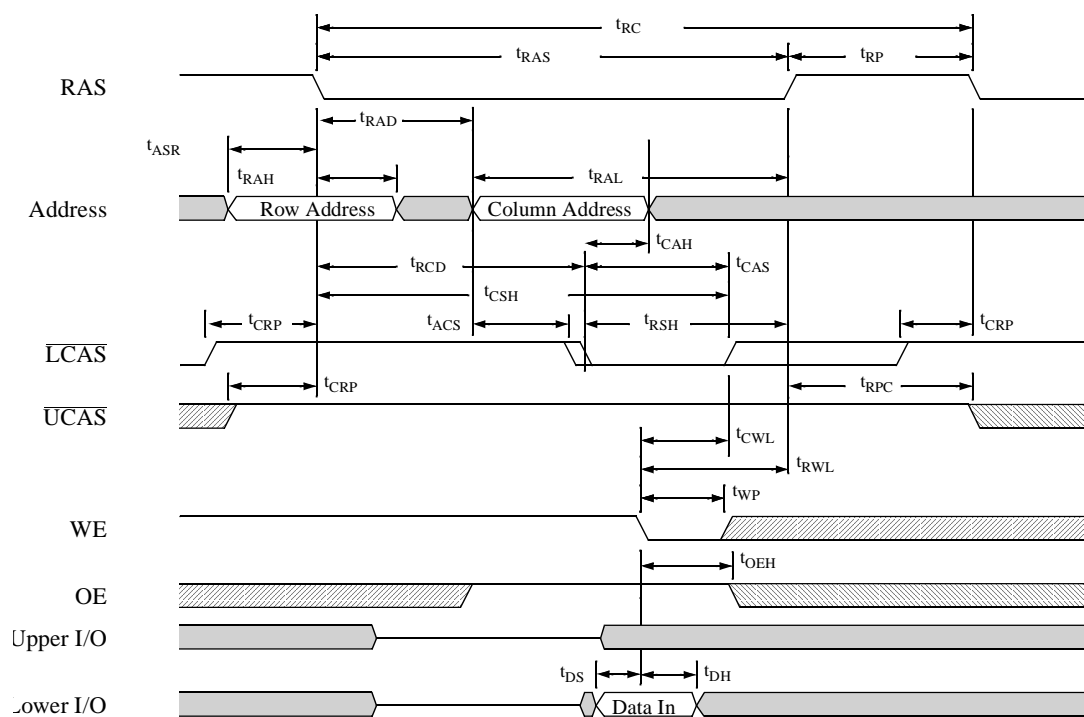
TIMING WAVEFORM OF UPPER BYTE WRITE CYCLE

(OE Controlled)

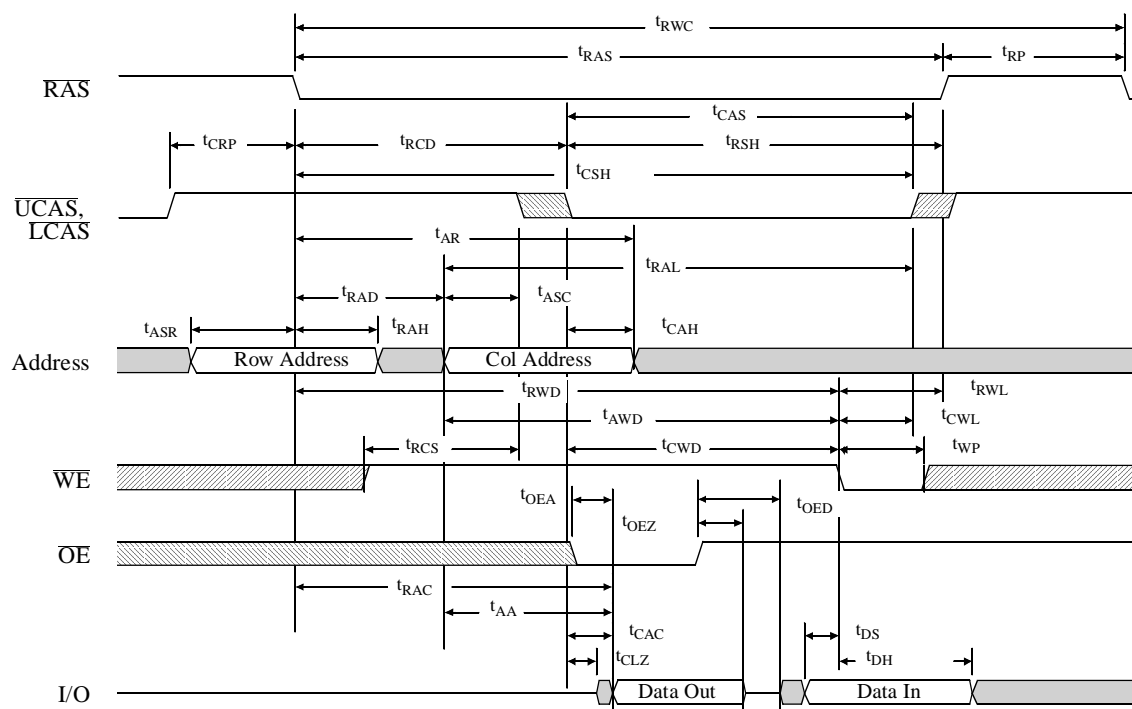




TIMING WAVEFORM OF LOWER BYTE WRITE CYCLE

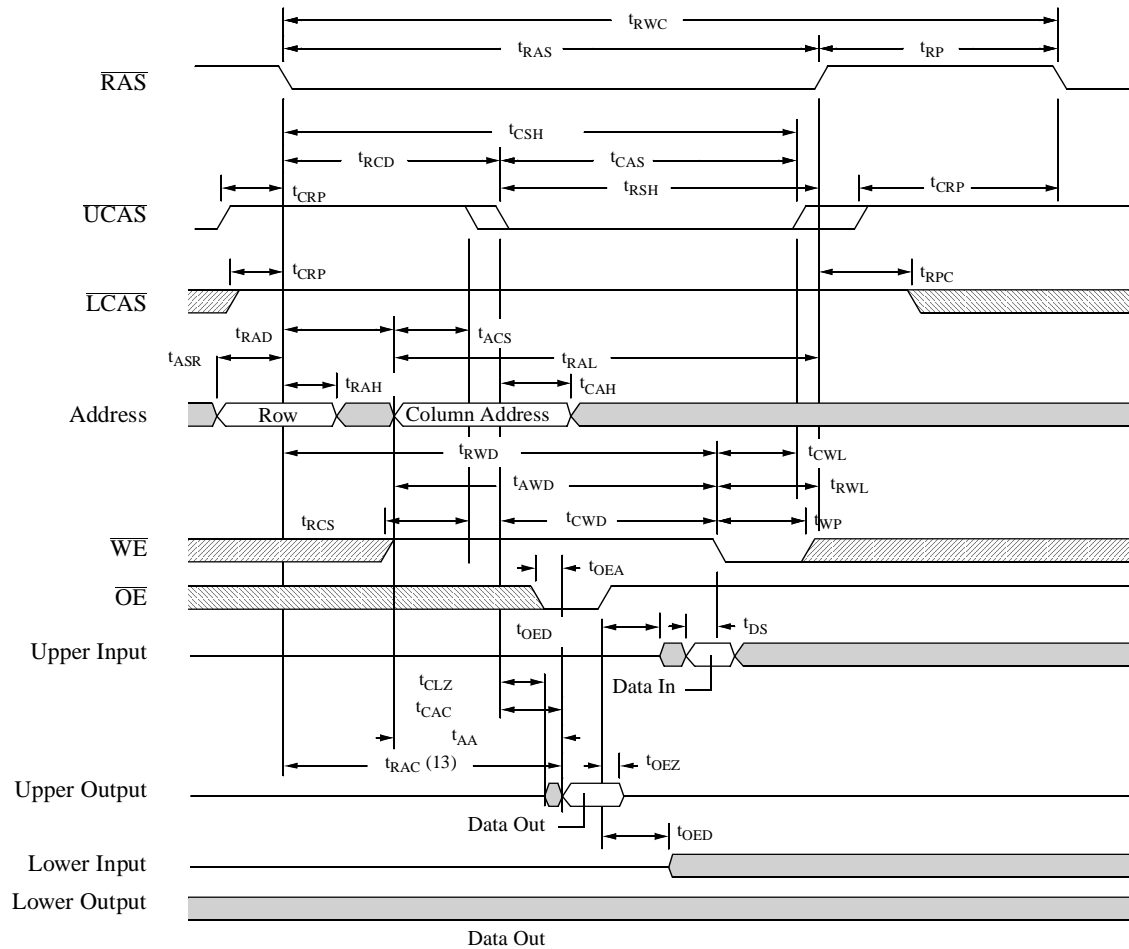
(
 $\overline{\text{OE}}$
Controlled)


TIMING WAVEFORM OF READ-MODIFY-WRITE CYCLE



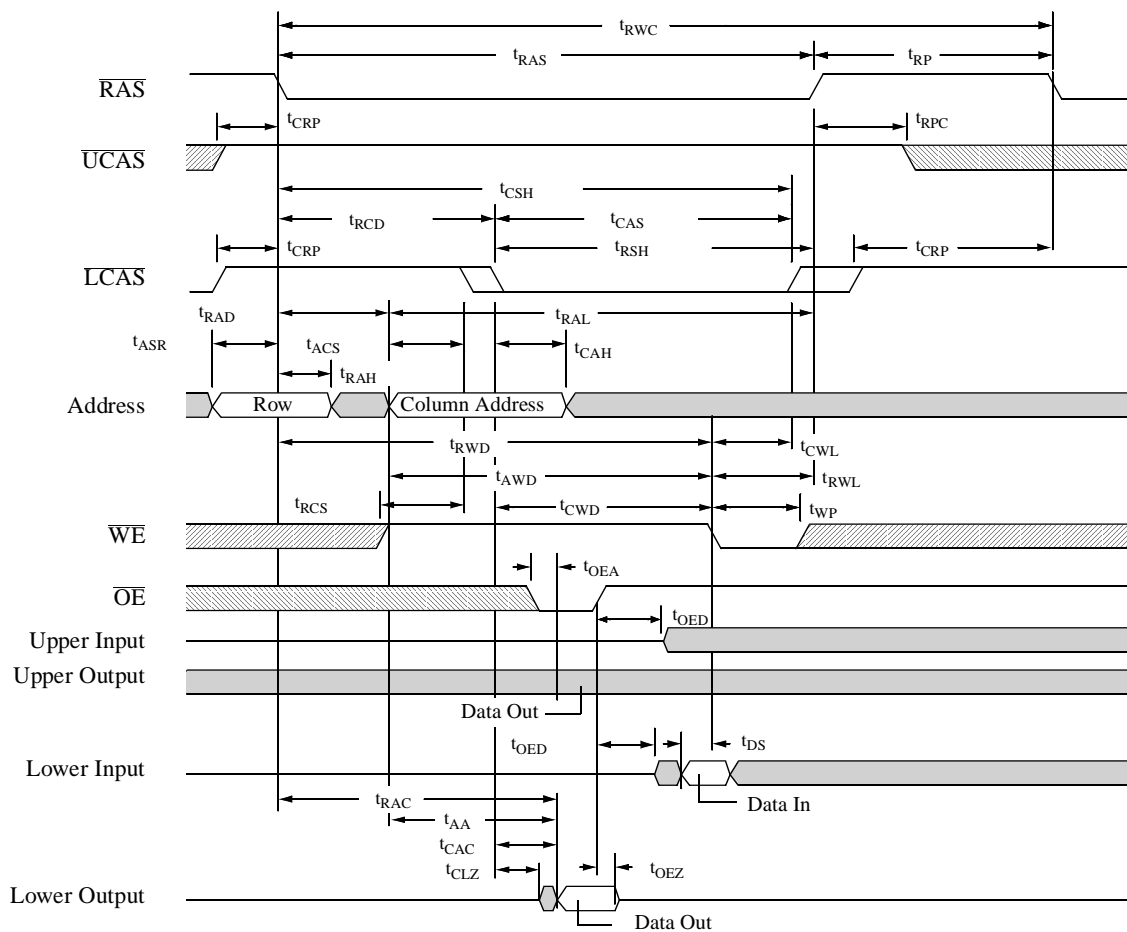


TIMING WAVEFORM OF UPPER BYTE READ-MODIFY-WRITE CYCLE



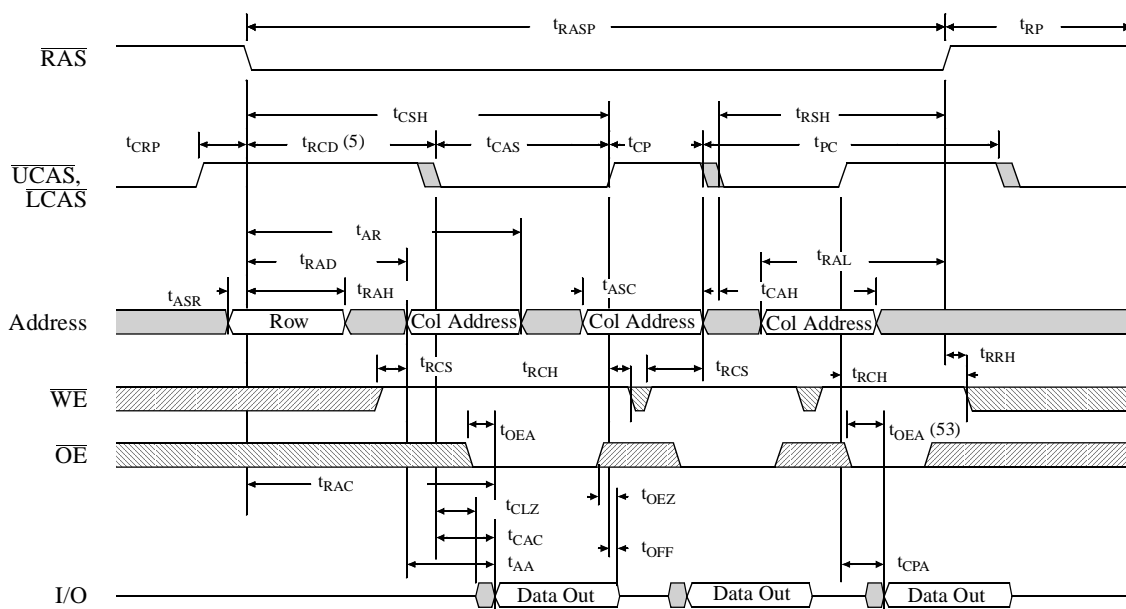


TIMING WAVEFORM OF LOWER BYTE READ-MODIFY-WRITE CYCLE

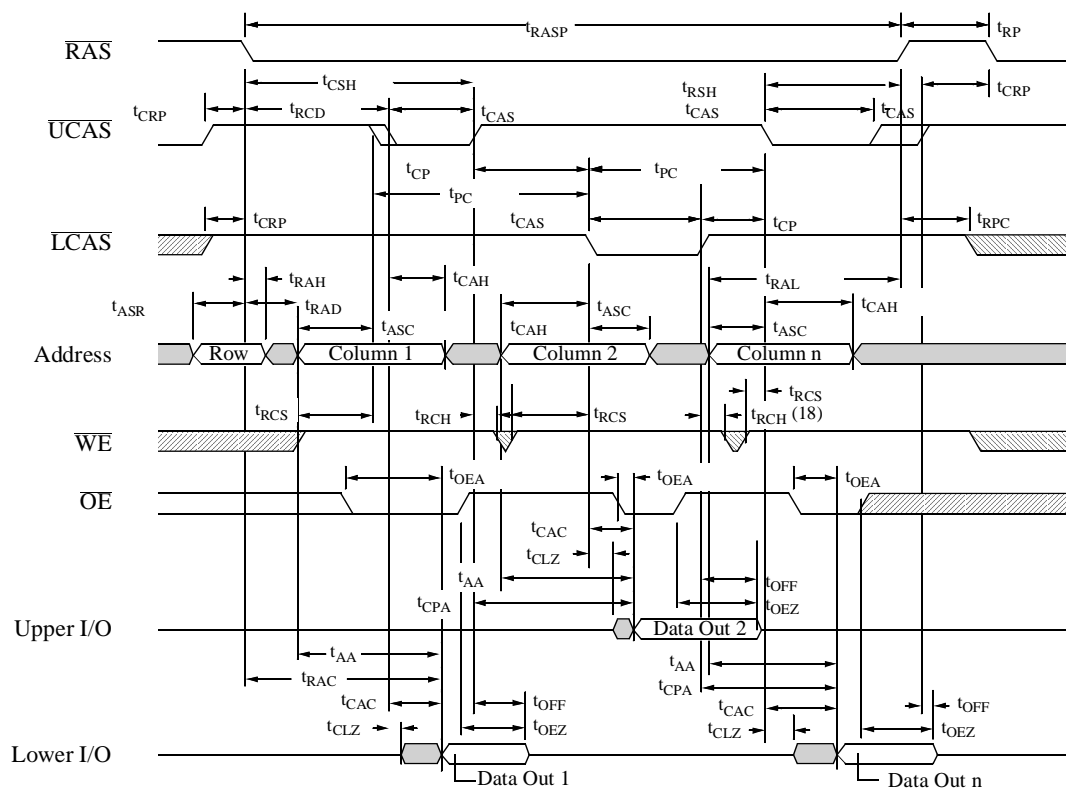




TIMING WAVEFORM OF FAST PAGE MODE READ CYCLE

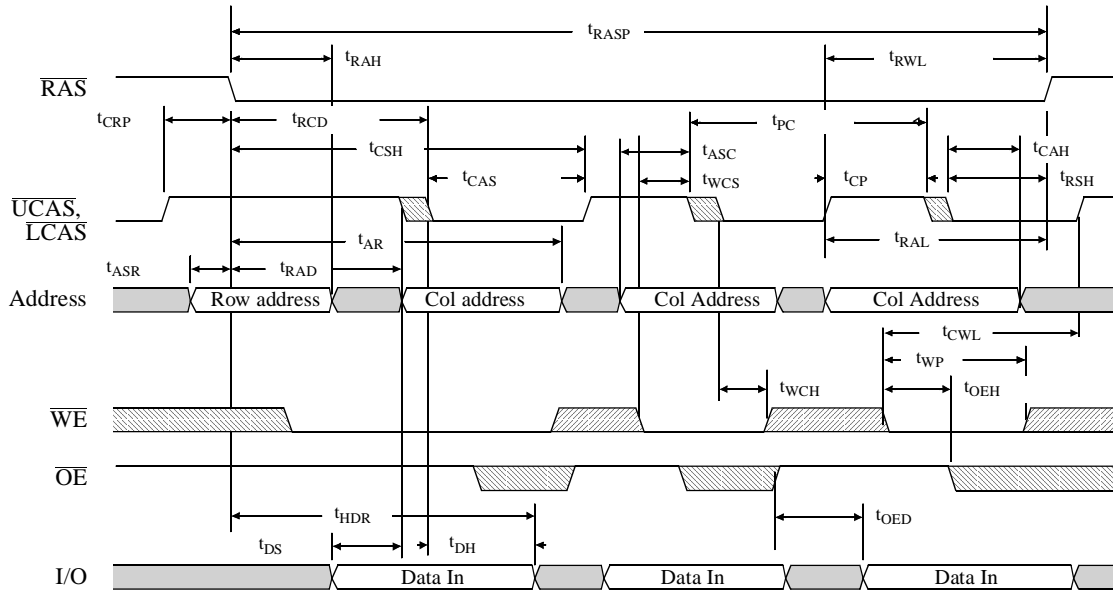


TIMING WAVEFORM OF FAST PAGE MODE BYTE READ CYCLE

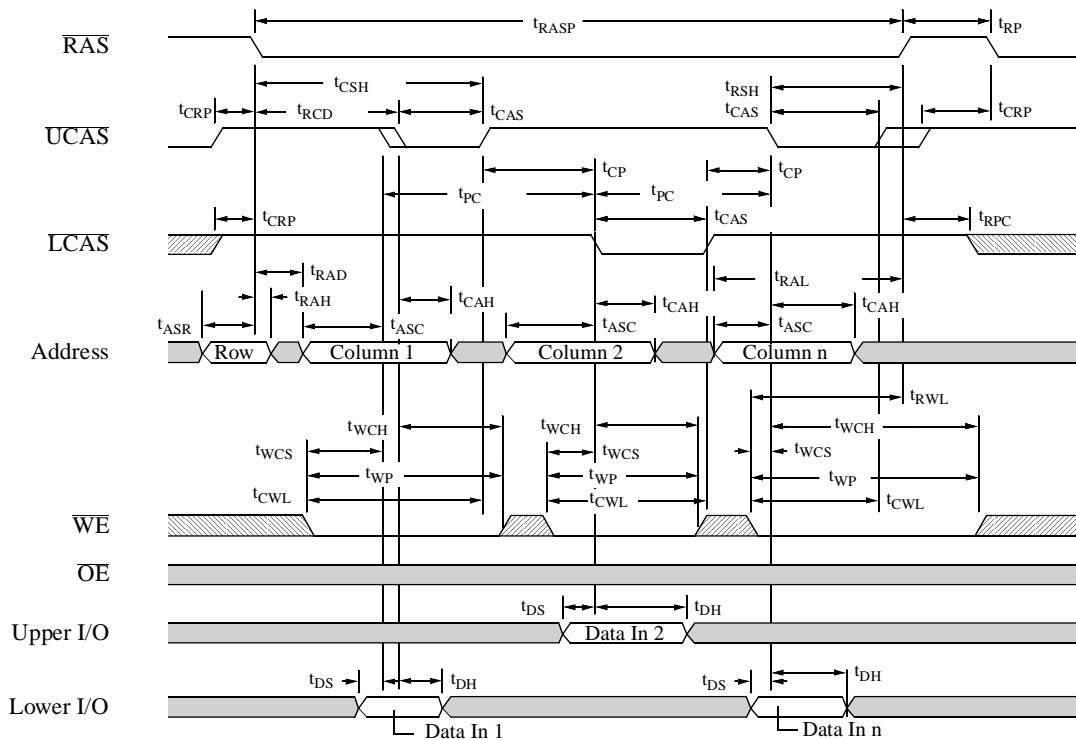




TIMING WAVEFORM OF FAST PAGE MODE EARLY WRITE CYCLE

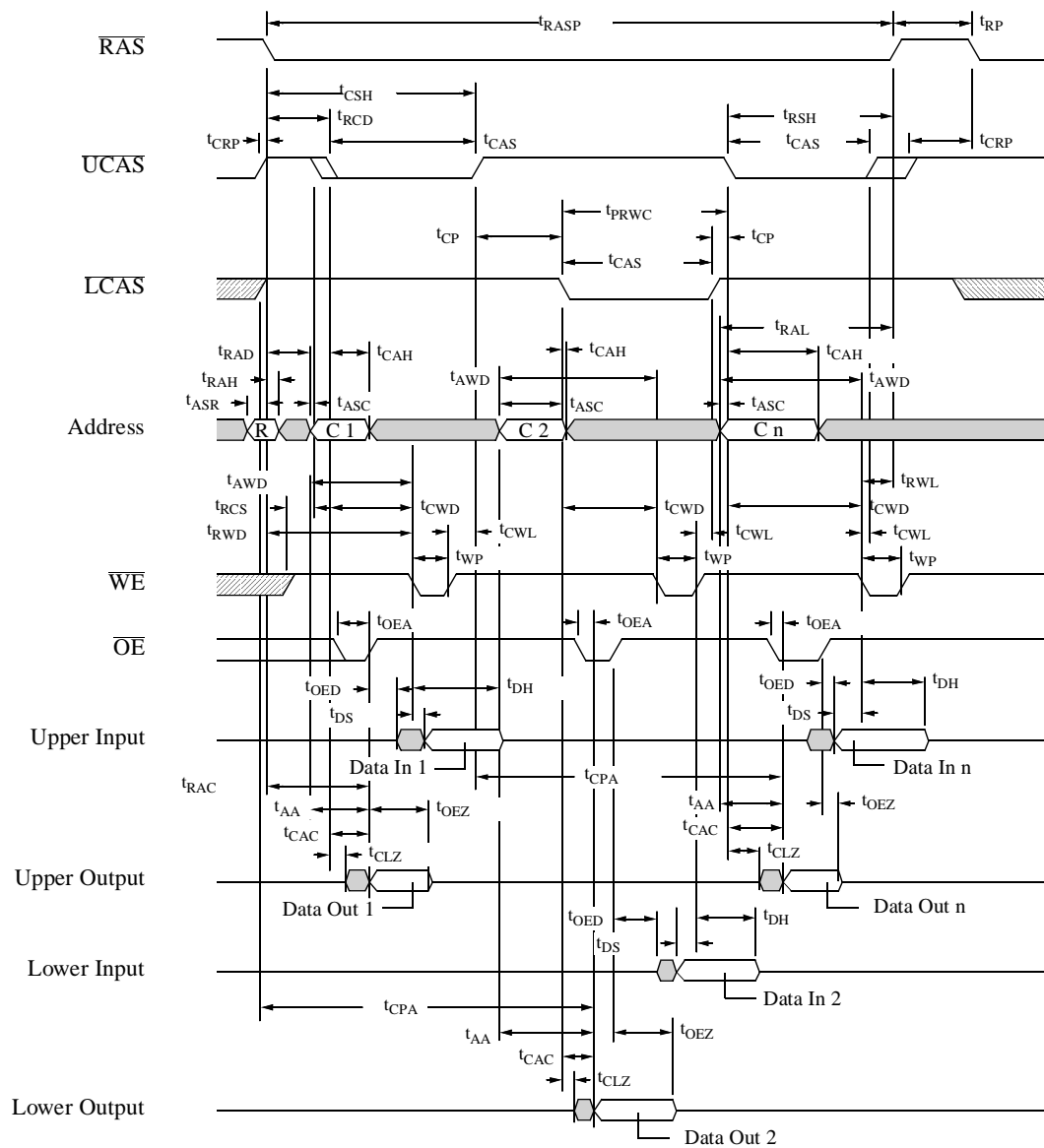


TIMING WAVEFORM OF FAST PAGE MODE BYTE EARLY WRITE CYCLE



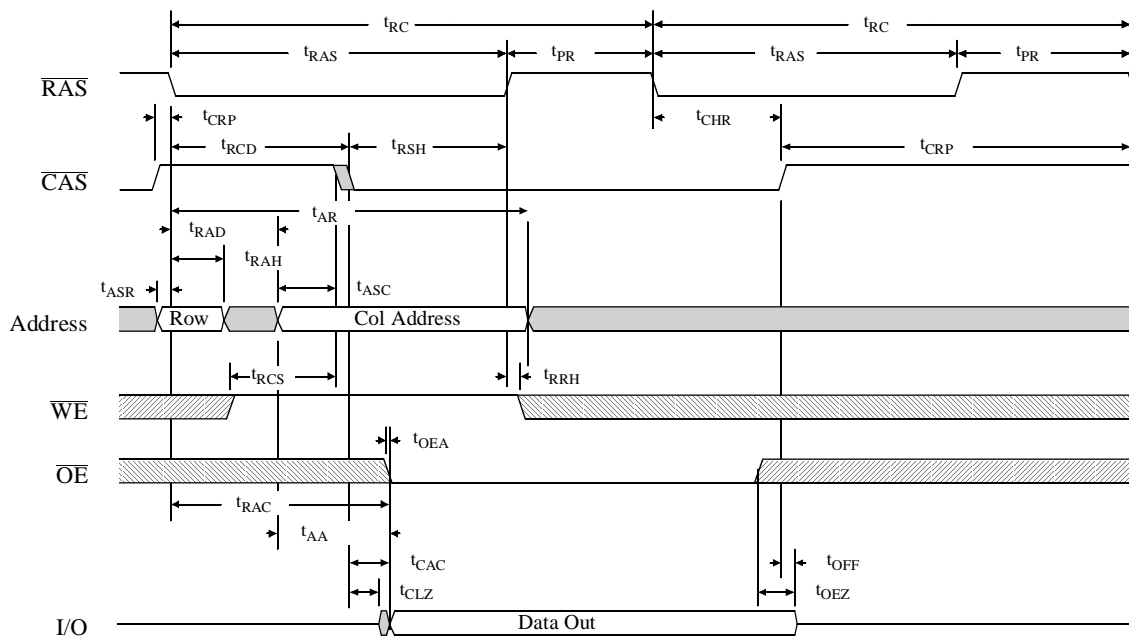


TIMING WAVEFORM OF FAST PAGE MODE BYTE READ-MODIFY-WRITE CYCLE

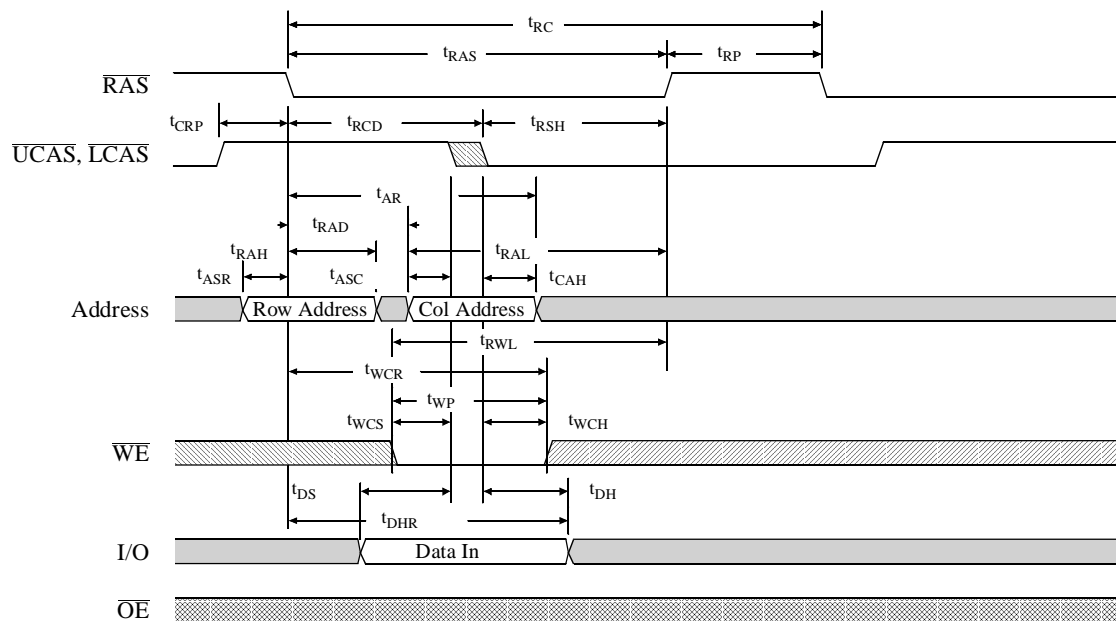




TIMING WAVEFORM OF HIDDEN REFRESH CYCLE (READ)

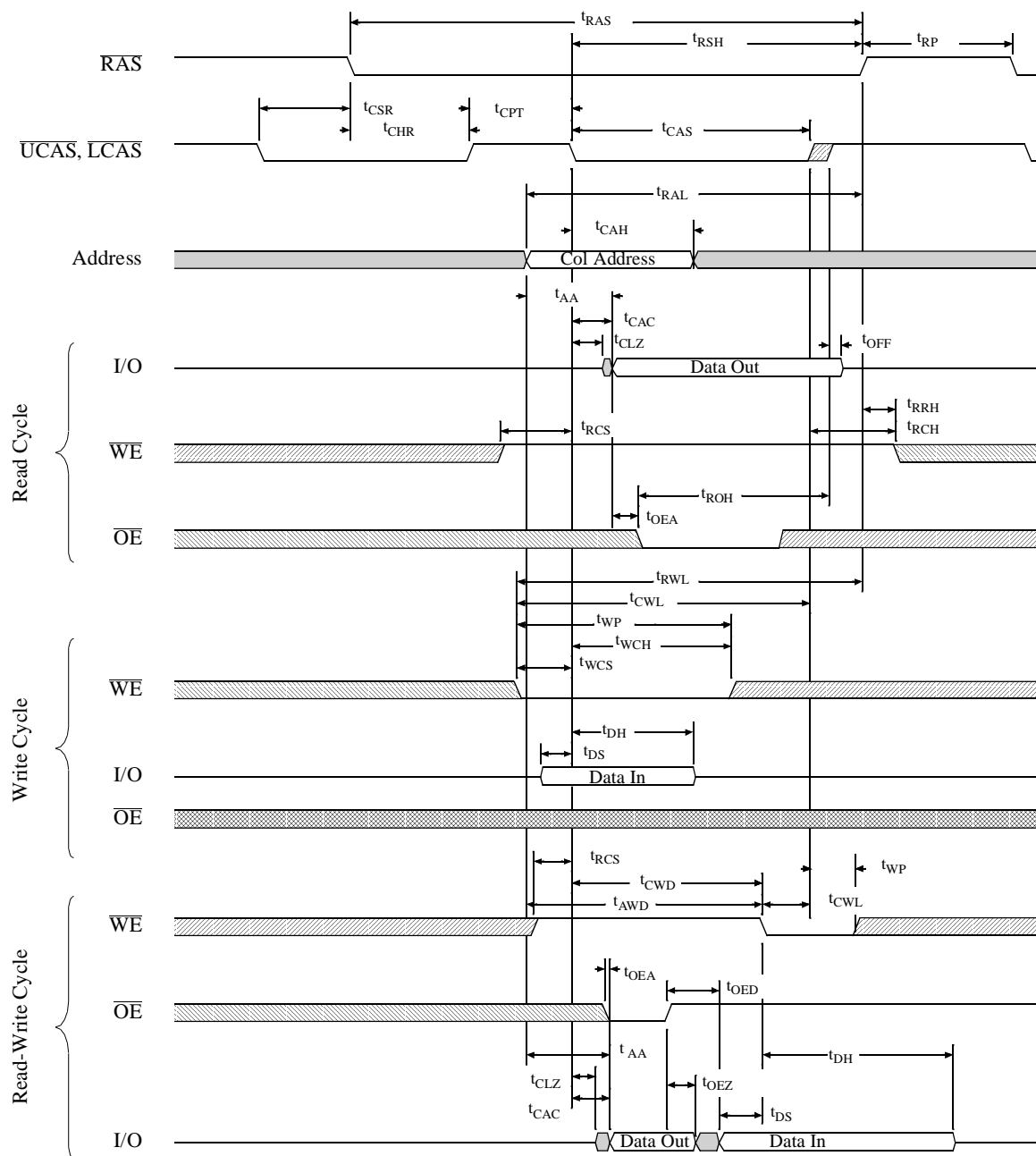


TIMING WAVEFORM OF HIDDEN REFRESH CYCLE (WRITE)





TIMING WAVEFORM OF $\overline{\text{CAS}}$ BEFORE $\overline{\text{RAS}}$ REFRESH COUNTER TEST CYCLE



**CAPACITANCE**¹⁵ $(f = 1 \text{ MHz}, T_a = \text{Room Temperature}, V_{CC} = 5V \pm 10\%)$

Parameter	Symbol	Signals	Test Conditions	Max	Unit
Input Capacitance	C_{IN1}	A0 to A8	$V_{in} = 0V$	5	pF
	C_{IN2}	RAS, UCAS, LCAS, WE, OE	$V_{in} = 0V$	7	pF
I/O Capacitance	$C_{I/O}$	I/O0 to I/O15	$V_{in} = V_{out} = 0V$	7	pF

ORDERING CODES

Package \ $\overline{\text{RAS}}$ Access Time	50 ns	60 ns
Plastic SOJ, 400 mil, 40-pin	AS4C256K16F0-50JC	AS4C256K16F0-60JC

Shaded areas contain advance information.

PART NUMBERING SYSTEM

AS4C	256K16	F0	-XX	X	C
DRAM Prefix	Device Number	Fast Page Mode	$\overline{\text{RAS}}$ Access Time	Package: J = SOJ 400 mil	Commercial Temperature Range, 0°C to 70 °C



REPRESENTATIVES AND DISTRIBUTORS

DOMESTIC REPS

ALABAMA

Concord Component Reps
190 Lime Quarry, Suite #102
Madison, AL 35758
(205) 772-8883

ARKANSAS

Southern States Marketing
1702 N. Collins Blvd., Suite #250
Richardson, TX 75080
(214) 238-7500

CALIFORNIA

North:

Brooks Technical Group
883 N. Shoreline Blvd.
Mountain View, CA 94043
(415) 960-3880

South:

Action Technical Sales
2137 Newcastle Avenue
Cardiff, CA 92007-1824
(619) 634-1488

Competitive Technology
16253 Laguna Canyon Road
Suite #160
Irvine, CA 92718
(714) 450-0170

COLORADO

Technology Sales
1720 South Bellaire Street
Suite #910
Denver, CO 80222
(303) 692-8835

CONNECTICUT

Kitchen & Kutchin Associates
154 State St.
North Haven, CT 06473
(203) 239-0212

DELAWARE

Electro Tech
621 E. Germantown Pike,
Suite #202
Norristown, PA 19401-2454
(610) 272-2125

FLORIDA

Micro-Electronic Components Corp.
400 Fairway Drive, Suite #107
Deerfield Beach, FL 33441
(954) 426-8944

Micro-Electronic Components Corp.
822 Riverbend Blvd.
Longwood, FL 32779
(407) 682-9602

Micro-Electronic Components Corp.
10637 Harborside Drive, North Largo, FL 34643
(813) 393-5011

GEORGIA

Concord Component Reps
6825 Jimmy Carter Blvd. 1303
Norcross, GA 30071
(770) 416-9597

HAWAII

Brooks Technical Group
883 N. Shoreline Blvd.
Mountain View, CA 94043
(415) 960-3880

IDAHO

ES/Chase
6655 SW Hampton, Suite #120
Tigard, OR 97223
(503) 684-8500

ILLINOIS

El-Mech
3511 N. Cicero Avenue
Chicago, IL 60641
(312) 794-9100

CenTech
3751 Pennridge Dr., Suite #107
Bridgeton, MO 63044
(314) 291-4230

INDIANA

CC Electro Sales
1843 N. Meridian Street
Indianapolis, IN 46202-1411
(317) 921-5000

KANSAS

CenTech
10312 East 63rd Terrace
Raytown, MO 64133
(816) 358-8100

KENTUCKY

CC Electro Sales
1843 N. Meridian Street
Indianapolis, IN 46202-1411
(317) 921-5000

LOUISIANA

Southern States Marketing
13831 NW Freeway, Suite #151
Houston, TX 77040
(713) 895-8533

Southern States Marketing
1702 N. Collins Blvd., Suite #250
Richardson, TX 75080
(214) 238-7500

MAINE

Kitchen & Kutchin Associates
87 Cambridge Street
Burlington, MA 01803
(617) 229-2660

MARYLAND

Chesapeake Technology
3905 National Drive, Suite #425
Burtosville, MD 20866
(301) 236-0530

MASSACHUSETTS

Kitchen & Kutchin Associates
87 Cambridge Street
Burlington, MA 01803
(617) 229-2660

MICHIGAN

Enco Group
799 Industrial Court
Bloomfield Hills, MI 48302
(810) 338-8600

MINNESOTA

D.A. Case Associates
4620 W. 77th Street Suite #250
Minneapolis, MN 55435
(612) 831-6777

MISSOURI

CenTech
3751 Pennridge Dr., Suite #107
Bridgeton, MO 63044
(314) 291-4230

CenTech
10312 East 63rd Terrace
Raytown, MO 64133
(816) 358-8100

MISSISSIPPI

Concord Component Reps
190 Lime Quarry, Suite #102
Madison, AL 35758
(205) 772-8883

MONTANA

ES/Chase
6655 SW Hampton, Suite #120
Tigard, OR 97223
(503) 684-8500

NEBRASKA

CenTech
10312 East 63rd Terrace
Raytown, MO 64133
(816) 358-8100

NEVADA

Brooks Technical Group
883 N. Shoreline Blvd.
Mountain View, CA 94043
(415) 960-3880

NEW HAMPSHIRE

Kitchen & Kutchin Associates
87 Cambridge Street
Burlington, MA 01803
(617) 229-2660

NEW JERSEY

ERA Associates
354 Veterans Memorial Hwy
Commack, NY 11725
(800) 645-5500

Electro Tech
621 E. Germantown Pike
Suite #202
Norristown, PA 19401-2454
(610) 272-2125

NEW YORK

ERA Associates
354 Veterans Memorial Hwy
Commack, NY 11725
(516) 543-0510

Tri-Tech Electronics
1043 Front Street
Binghamton, NY 13905
(607) 722-3580

Tri-Tech Electronics
349 W. Commercial Street
Suite #2585
East Rochester, NY 14445
(716) 385-6500

NORTH CAROLINA

Concord Component Reps
10608 Dunhill Terrace
Raleigh, NC 27615
(919) 846-3441

NORTH DAKOTA

D.A. Case Associates
4620 W. 77th Street Suite #250
Minneapolis, MN 55435
(612) 831-6777

OHIO

Midwest Marketing Associates
5001 Mayfield Road Suite #319
Lyndhurst, OH 44124
(216) 381-8575

Midwest Marketing Associates
30 Marco Lane
Dayton, OH 45458
(513) 433-2511

OKLAHOMA

Southern States Marketing
1702 N. Collins Blvd., Suite #250
Richardson, TX 75080
(214) 238-7500

OREGON

ES/Chase
6655 SW Hampton, Suite #120
Tigard, OR 97223
(503) 684-8500

PENNSYLVANIA

Electro Tech
621 E. Germantown Pike
Suite #202
Norristown, PA 19401-2454
(610) 272-2125

Midwest Marketing Associates
5001 Mayfield Road Suite #319
Lyndhurst, OH 44124
(216) 381-8575

RHODE ISLAND

Kitchen & Kutchin Associates
87 Cambridge Street
Burlington, MA 01803
(617) 229-2660

SOUTH CAROLINA

Concord Component Reps
10608 Dunhill Terrace
Raleigh, NC 27615
(919) 846-3441

SOUTH DAKOTA

D.A. Case Associates
4620 W. 77th Street
Suite #250
Minneapolis, MN 55435
(612) 831-6777

TENNESSEE

Concord Component Reps
190 Lime Quarry, Suite #102
Madison, AL 35758
(205) 772-8883

TEXAS

Southern States Marketing
400 Anderson Lane
Suite #118
Austin, TX 78752
(512) 835-5822

Southern States Marketing
13831 NW Freeway
Suite #151
Houston, TX 77040
(713) 895-8533

Southern States Marketing
1702 N. Collins Blvd.
Suite #250
Richardson, TX 75080
(214) 238-7500

UTAH

Charles Fields & Associates
103 East 650 North
Bountiful, UT 84010
(801) 299-8228

VERMONT

Kitchen & Kutchin Associates
87 Cambridge Street
Burlington, MA 01803
(617) 229-2660

VIRGINIA

Chesapeake Technology
3905 National Drive
Suite #425
Burtonsville, MD 20866
(301) 236-0530

WASHINGTON

ES/Chase
12025 115th Avenue NE
Suite #200
Kirkland, WA 98034
(206) 823-9535

WEST VIRGINIA

Chesapeake Technology
3905 National Drive
Suite #425
Burtonsville, MD 20866
(301) 236-0530

WISCONSIN

D.A. Case Associates
4620 W. 77th Street
Suite #250
Minneapolis, MN 55435
(612) 831-6777

WYOMING

Technology Sales
1720 South Bellaire Street
Suite #910
Denver, CO 80222
(303) 692-8835

KOREA

FM Korea
6th Fl. Bando Bldg
48-1, Banpo-dong, Seocho-ku
Seoul 137 140 Korea
+822-596-3880

fm@kmet.co.kr

Woo Young Tech Co., Ltd.

5th Floor Koami Bldg., 13-31
Yoido-dong, Youngdeungpo-ku
Seoul, Korea
+822-369-7099

MALAYSIA

Exertec Pte Ltd.

Blk 1A/14/07 Sunnyville
No. 1 Jalan Batu Uban
Gelugor, Penang 11700 Malaysia
+60-4-657-9592

PUERTO RICO

MEC/Caribe
P.O. Box 5038
Caguas, PR 00726
(787) 746-9897

SINGAPORE

Exertec Pte Ltd.
5 Kallang Sector #04-01
349279 Singapore
+65-749-1349

TAIWAN

ASTL
Room A3, 10th Fl.
No. 58 Sec. 1
Ming-Sheng Road
Taipei, Taiwan R.O.C.
+886-2-521-2363

Golden Way

7F-3, 75, Hsin Tai Wu Road
Sec. 1, His-Chih
Taipei-Hsien Taiwan R.O.C.
+886-2-698-1868 x505

Puteam International
9F-5, 391 Sec. 4 Hsin-Yi Road
Taipei, Taiwan R.O.C.
+886-2-729-0373

SALES OFFICES

HEADQUARTERS

Alliance Semiconductor
San Jose, CA
Tel: (408) 383-4900
Fax: (408) 383-4999
BBS: (408) 383-4994

NORTHEAST AREA

Alliance Semiconductor
Boston, MA
(617) 239-8127

TECHNICAL CENTER

TAIWAN

Alliance Semiconductor
11F, NO.66, Sec. 2
Jang Kuo N. Road
Taipei, Taiwan R.O.C.
Tel: +886-2-516-7995
Fax: +886-2-517-4928
alliance@mail.tpe.wownet.net

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ALLIANCE SEMICONDUCTOR

3099 North First Street San Jose, CA 95134 Tel (408) 383-4900 Fax (408) 383-4999 BBS: (408) 383-4994 www.alsc.com
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