

MD32256FKX

256K x 32 CMOS DRAM Module

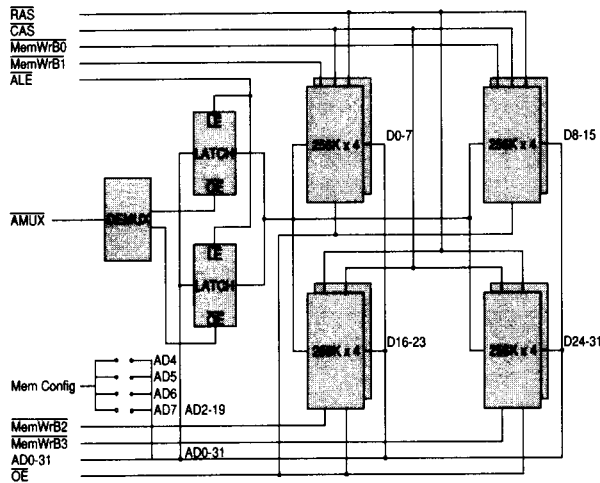
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262,144 x 32 CMOS High Speed Dynamic RAM

Features

- Row Access Times of 100/120/150 ns
- Onboard Address Latching
- Onboard Address Multiplexing
- Byte Write Facility
- CAS Before RAS Refresh
- RAS Only Refresh
- Directly TTL Compatible
- MemConfig Option for Transputer Applications
- 512 Cycle Refresh in 8 ms (max)

Block Diagram



ADVANCE PRODUCT INFORMATION

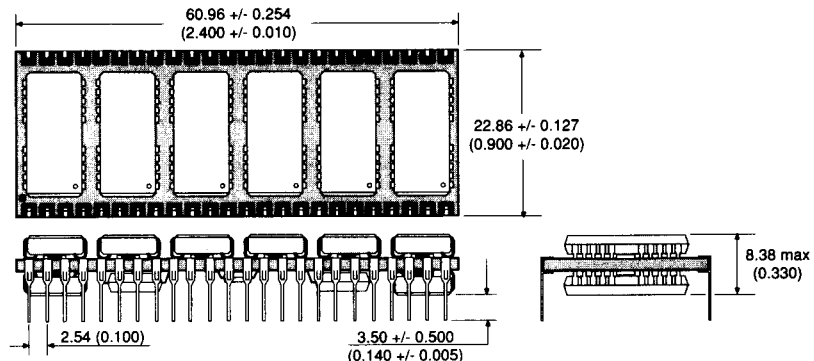
Pin Definition

V _{DD}	1	48	V _{CC}
CAS	2	47	RAS
AD0	3	46	AD31
AD1	4	45	AD30
AD2	5	44	AD29
AD3	6	43	AD28
AD4	7	42	AD27
AD5	8	41	AD26
AD6	9	40	AD25
AD7	10	39	AD24
MemWrB0	11	38	MemWrB3
V _{DD}	12	37	V _{DD}
Mem Config	13	36	OE
AMUX	14	35	ALE
MemWrB1	15	34	MemWrB2
AD8	16	33	AD23
AD9	17	32	AD22
AD10	18	31	AD21
AD11	19	30	AD20
AD12	20	29	AD19
AD13	21	28	AD18
AD14	22	27	AD17
AD15	23	26	AD16
V _{CC}	24	25	V _{DD}

Pin Functions

AD0-AD31	Address/Data I/O
CAS	Column Address Strobe
RAS	Row Address Strobe
MemWrB0-3	Byte Write
OE	Output Enable
AMUX	Address Multiplex
ALE	Address Latch Enable
Mem Config	Configure Memory
V _{CC}	Power (+5V)
V _{DD}	Ground

Package Details Dimensions in mm (inches).



Absolute Maximum Ratings

Voltage Range on any pin	-1 to $V_{CC}^{+0.3}$	V
Voltage Range on V_{CC}	0 to 7	V
Short Circuit Output Current	50	mA
Power Dissipation	8	W
Operating Free-air Temperature Range	0 to 70	°C
Storage Temperature	-65 to +150	°C

Recommended Operating Conditions

		min	typ	max	
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Input High Voltage	V_{IH}	2.4	-	6.5	V
Input Low Voltage	V_{IL}	-2.0	-	0.8	V
Output High Voltage	V_{OH}	2.4	-	V_{CC}	V
Output Low Voltage	V_{OL}	0	-	0.4	V
Operating Temperature	T_a	0	-	70	°C
	T_{al}	-40	-	85	°C (32256FKXI)

Capacitance ($V_{CC}=5V \pm 10\%$, $T_a=25^\circ C$)

Parameter	Symbol	Test Condition	typ	max	Unit
I/P Capacitance					
CAS, RAS, OE	C_{IN1}	$V_{IN1} = 0V$	-	56	pF
MemWrB0-3	C_{IN2}	$V_{IN2} = 0V$	-	14	pF
ALE	C_{IN3}	$V_{IN3} = 0V$	-	10	pF
AMUX	C_{IN4}	$V_{IN4} = 0V$	-	15	pF
I/O Capacitance, AD0 - AD31	$C_{I/O}$	$V_{I/O} = 0V$	-	17	pF

DC Electrical Characteristics

Parameter	Symbol	Test Condition	-10		-12 & -15		Unit
			min	max	min	max	
Input Leakage Current							
CAS, RAS, MemWrB0-3, OE	I_{i1}		-	+/-80	-	+/-80	μA
AD2 - AD19	I_{i2}		-600	20	-600	20	μA
ALE	I_{i3}		-1200	40	-1200	40	μA
AMUX	I_{i4}		-1800	60	-1800	60	μA
I/O Leakage Current	I_{i0}		-	+/-80	-	+/-80	μA
Read/Write Cycle Current	I_{cc1}		-	685	-	645	mA
Standby Current	I_{cc2}	$V_{IH}=5.5V$	-	110	-	110	mA
Average Refresh Current	I_{cc3}		-	645	-	605	mA

AC Test Conditions

- * Input pulse levels: Gnd to 3.0V
- * Input rise and fall times: 5ns
- * Input and Output timing reference levels: 1.5V
- * Output load: 1 TTL gate + 100pF
- * $V_{CC}=5V \pm 10\%$

Description

The MD32256FKX is a high speed 8,388,608 bit Dynamic Random Access Memory organised as 262,144 words of 32 bits each. Although designed primarily for use with Transputers, it can be used with any system which supports Dynamic Memory and a 32 bit Multiplexed Address / Data Bus. Information on interfacing this part with both Transputers and other systems is given below.

Transputer Operation

Four different Memory Configuration options are provided via the MemConfig pin. This pin is connected, at the manufacturing stage, to one of the Address / Data pins AD4, AD5, AD6, AD7, the particular option specified by the customer when ordering. This allows for a wide range of memory speed and Transputer speed configurations to be used, depending on the application, as shown in the table below.

Memory Speed (nS)	Transputer Speed (MHz)												
	15				17				20				
	AD LINK		AD LINK		AD LINK		AD LINK		AD LINK		AD LINK		
	4	5	6	7	4	5	6	7	4	5	6	7	
100	●	●	●	●		●	●	●				●	●
120		●	●	●			●	●				●	●
150			●	●			●	●					●

● Indicates allowable combination

Connections to the Transputer are as follows :

Transputer Pin	MD32256 Pin
MemnotWrD0	AD0
MemnotRfD1	AD1
MemAD2-MemAD31	AD2-AD31
notMemS0	ALE
notMemS1	RAS
notMemS2	AMUX
notMemS3	CAS
MemConfig	MemConfig
notMemRd	OE
notMemWrB0-3	MemWrB0-3

General Operation

The MD32256 is a 256K x 32 bit Dynamic Memory with a multiplexed Address / Data bus. This device has on board address latches and address multiplexing, which reduces the complexity of external circuitry. This data sheet describes the use of this memory in normal READ and WRITE modes and EARLY WRITE mode, as well as two types of REFRESH.

Address AD2 - AD19

18 Address bits are required to decode 1 of 256K locations. This 18 bit address is converted by the on board circuitry to two 9 bit addresses for use by the 256K x 4 DRAMS used, and strobed into the DRAMS by using the RAS and CAS control inputs.

MemWrB0 - MemWrB3

The READ or WRITE mode is selected by these inputs, a separate input provided for each byte, the least significant byte controlled by MemWrB0. A logic high on these inputs selects the READ mode and a logic low selects the WRITE mode. The data input is disabled when the READ mode selected. When MemWrB0 - 3 go low prior to $\overline{\text{CAS}}$ (early write), data out will remain in the high impedance state for the entire cycle, permitting a WRITE operation with OE grounded.

Data IN AD0 - AD31

Data is written during a WRITE or EARLY WRITE cycle. In an EARLY WRITE cycle, MemWrB0-3 are brought low before CAS and the data is strobed by CAS. In a WRITE cycle, CAS is already low so the data is strobed in by MemWrB0-3; note that OE must be high to put the output buffers into a high impedance state before placing data onto AD0 - AD31.

See diagrams showing WRITE and EARLY WRITE waveforms for detailed timing.

Data OUT AD0 - AD31

The three state output buffer is in the high impedance state until both CAS and RAS are brought low. In a READ cycle the output becomes valid after the access time interval t_{CAC} , and remains valid while CAS and OE are low. Either $\overline{\text{CAS}}$ or OE going high returns it to the high impedance state.

See diagram showing READ waveform for detailed timing.



Output Enable \overline{OE}

When \overline{OE} is high the output buffers are in the high impedance state. Bringing \overline{OE} low during a normal cycle will place the output buffers in the low impedance state, as long as \overline{RAS} and \overline{CAS} are low as well. If either \overline{OE} or \overline{CAS} are brought high the buffers will return to the high impedance state.

Address Latch Enable \overline{ALE}

On the high to low transition of \overline{ALE} the address on the lines AD2 - AD19 is latched, and remains latched until \overline{ALE} goes high. With \overline{ALE} low these latches operate transparently i.e. the data on the outputs follows the inputs.

Address Latch Multiplex \overline{AMUX}

When \overline{AMUX} is high the address on AD2 - AD10 (row address) is presented to the DRAMS and is latched onto them when \overline{RAS} goes low. When \overline{AMUX} is low the address on AD11 - AD19 is used, and latched onto the DRAMS when \overline{CAS} goes low.

Refresh \overline{RAS} Only

A refresh operation must be performed once every 8 ms to retain stored data, achieved by strobing one of the 512 rows. A normal READ or WRITE cycle will refresh all of the bits in each row that is selected. For \overline{RAS} only refresh, \overline{CAS} is held high and an externally generated row address must be supplied on AD2 - AD10.

See diagram showing \overline{RAS} only refresh for detailed timing.

Refresh \overline{CAS} Before \overline{RAS}

The refresh address can be generated automatically by bringing \overline{CAS} low earlier than \overline{RAS} and holding it low while cycling \overline{RAS} . In this mode the external address is ignored.

Power Up

To achieve correct device operation, after V_{CC} has reached its full level a delay of 200us is required followed by eight initialisation cycles (READ, WRITE or REFRESH).

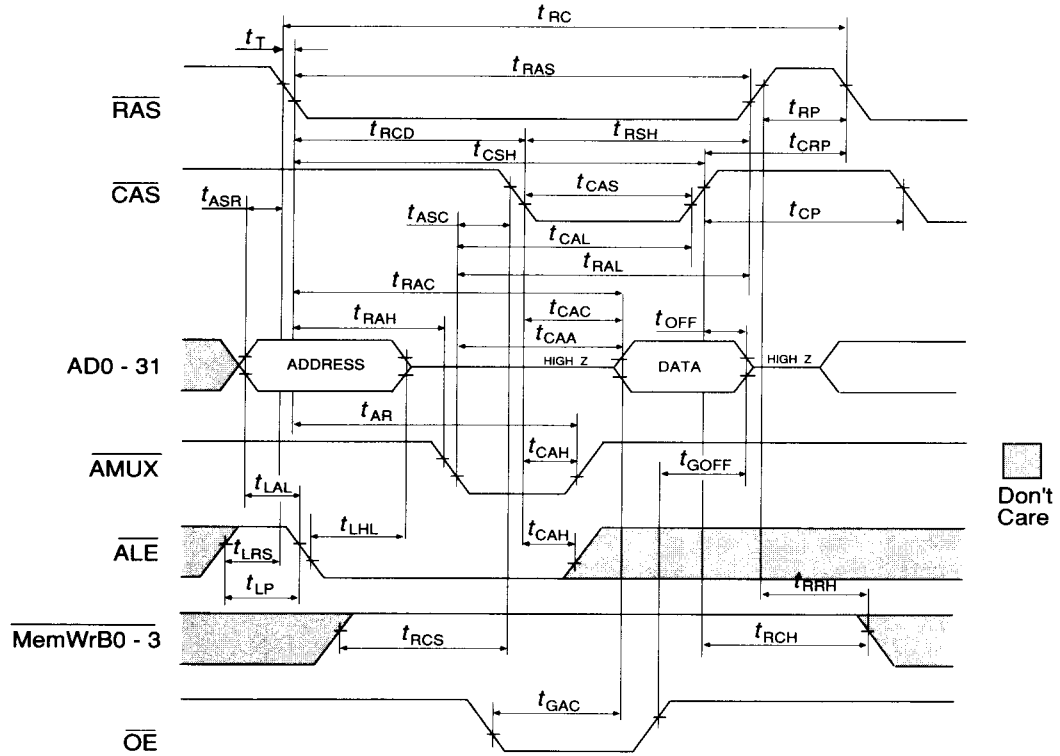
Electrical Characteristics & Recommended AC Operating Conditions

Parameter	Symbol	-10		-12		-15		Unit	Notes
		min	max	min	max	min	max		
Read Cycle Time	t_{RC}	190	-	220	-	260	-	ns	2
Transition Time	t_T	3	50	3	50	3	50	ns	
Non-static Column Decode Mode									
Pulse Duration, \overline{RAS} Low	t_{RAS}	100	10000	120	10000	150	10000	ns	
Delay Time, \overline{RAS} Low to \overline{CAS} Low	t_{RCD}	25	50	25	60	30	75	ns	8 & 10
Delay Time, CAS Low to \overline{RAS} High	t_{RSH}	50	-	60	-	75	-	ns	8
Pulse Duration, \overline{RAS} High (Precharge)	t_{RP}	80	-	90	-	100	-	ns	
Delay Time, \overline{RAS} Low to \overline{CAS} High	t_{CSH}	100	-	120	-	150	-	ns	
Delay Time, CAS High to \overline{RAS} Low	t_{CRP}	10	-	10	-	10	-	ns	
Pulse Duration, \overline{CAS} Low	t_{CAS}	50	10000	60	10000	75	10000	ns	
Column Address Setup Time Before									
\overline{CAS} Low	t_{ASC}	0	-	0	-	0	-	ns	
Pulse Duration, \overline{CAS} High	t_{CP}	10	-	15	-	20	-	ns	
Row Address Hold Time After \overline{RAS} Low	t_{RAH}	15	-	15	-	20	-	ns	
Delay Time, Column Address to \overline{CAS} High	t_{CAL}	70	-	80	-	95	-	ns	
Row Address Setup Time Before \overline{RAS} Low	t_{ASR}	10	-	10	-	10	-	ns	
Delay Time, Column Address to \overline{RAS} High	t_{RAL}	70	-	80	-	95	-	ns	
Column Address Hold Time After \overline{RAS} Low	t_{AR}	75	-	85	-	110	-	ns	7
Read Hold Time After \overline{RAS} High	t_{RRH}	10	-	10	-	10	-	ns	
Read Setup Time Before \overline{CAS} Low	t_{RCS}	0	-	0	-	0	-	ns	
Column Address Hold Time After \overline{CAS} Low	t_{CAH}	20	-	20	-	25	-	ns	
Read Hold Time After \overline{CAS} High	t_{RCH}	0	-	0	-	0	-	ns	
Access Time From \overline{CAS} Low	t_{CAC}	-	50	-	60	-	75	ns	
Access Time From Column Address	t_{CAA}	-	70	-	80	-	95	ns	
Output Disable Time After \overline{CAS} High	t_{OFF}	0	25	0	30	0	35	ns	1
Access Time From \overline{RAS} Low	t_{RAC}	-	100	-	120	-	150	ns	
Access Time From \overline{OE} Low	t_{GAC}	-	25	-	30	-	40	ns	
Output Disable Time After \overline{OE} High	t_{GOFF}	0	25	0	30	0	40	ns	1
Write Cycle Time	t_{WC}	190	-	220	-	260	-	ns	
Write Pulse Duration	t_{WP}	15	-	20	-	25	-	ns	
Write Hold Time After \overline{RAS} Low	t_{WCR}	70	-	85	-	110	-	ns	6 & 7
MemWr Low Setup Time Before \overline{CAS} High	t_{CWL}	35	-	40	-	45	-	ns	
MemWr Low Setup Time Before \overline{CAS} Low	t_{WCS}	0	-	0	-	0	-	ns	6
Write Hold Time After \overline{CAS} Low	t_{WCH}	20	-	25	-	30	-	ns	
MemWr Low Setup Time Before \overline{RAS} High	t_{RWL}	35	-	40	-	45	-	ns	
Data Setup Time Before \overline{CAS} Low	t_{DSC}	0	-	0	-	0	-	ns	5
Data Hold Time After \overline{CAS} Low	t_{DHC}	25	-	30	-	40	-	ns	5
Data Hold Time After \overline{RAS} Low	t_{DHR}	75	-	90	-	120	-	ns	7
Data Setup Time Before MemWr Low	t_{DSW}	0	-	0	-	0	-	ns	5
Data Hold Time After MemWr Low	t_{DHW}	25	-	30	-	40	-	ns	5
Delay Time, \overline{OE} High Before Data valid	t_{GDD}	30	-	35	-	45	-	ns	
Delay Time \overline{RAS} high to \overline{CAS} low	t_{RPC}	5	-	5	-	5	-	ns	3
Delay Time \overline{CAS} low to \overline{RAS} low	t_{CSR}	10	-	10	-	15	-	ns	3
Delay Time \overline{RAS} low to \overline{CAS} high	t_{CHR}	20	-	25	-	30	-	ns	3
Delay Time Address valid to \overline{ALE} low	t_{LAL}	10	-	10	-	10	-	ns	
Delay Time \overline{ALE} low to Address not valid	t_{LHL}	13	-	13	-	13	-	ns	
Delay Time \overline{ALE} high to Address valid	t_{LHH}	13	-	13	-	13	-	ns	
\overline{ALE} Pulse Duration, High	t_{LP}	4	-	4	-	4	-	ns	
Address Latch Setup Time	t_{LRS}	13	-	13	-	13	-	ns	

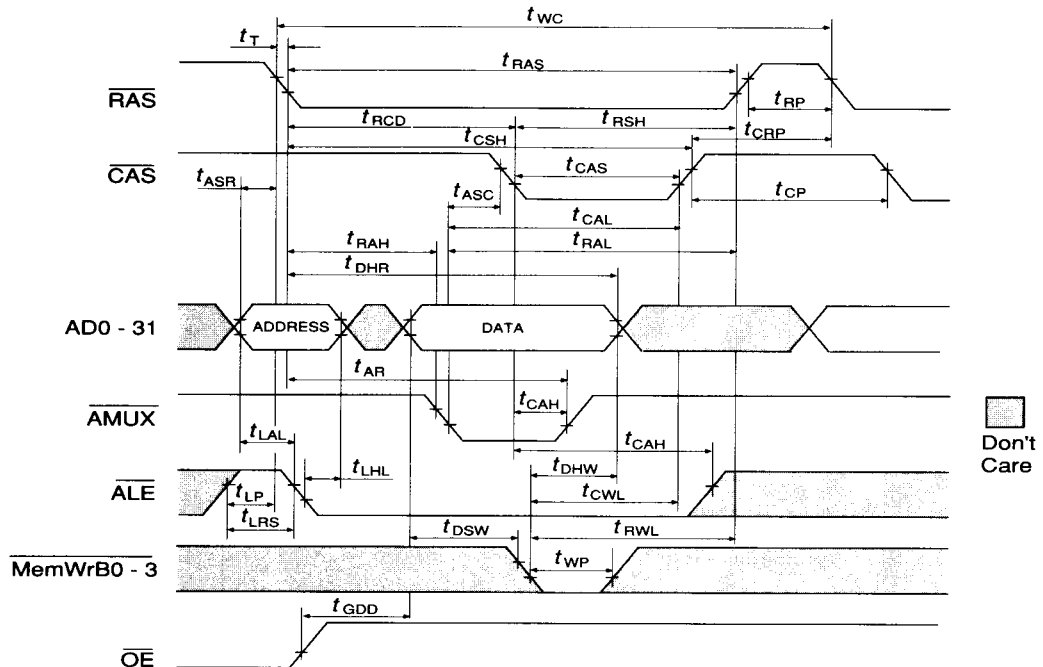
Notes :

- t_{OFF} and t_{GOFF} are specified when the output is no longer driven.
- All cycle times assume $t_r=5ns$.
- \overline{CAS} before \overline{RAS} refresh only.
- Later of \overline{CAS} or MemWr in write operation.
- Early write operation only.
- The minimum value is measured when t_{RAD} is set to t_{RAD} min as a reference.
- Read cycle only.
- Write cycle only.
- Maximum value specified only to guarantee access time.

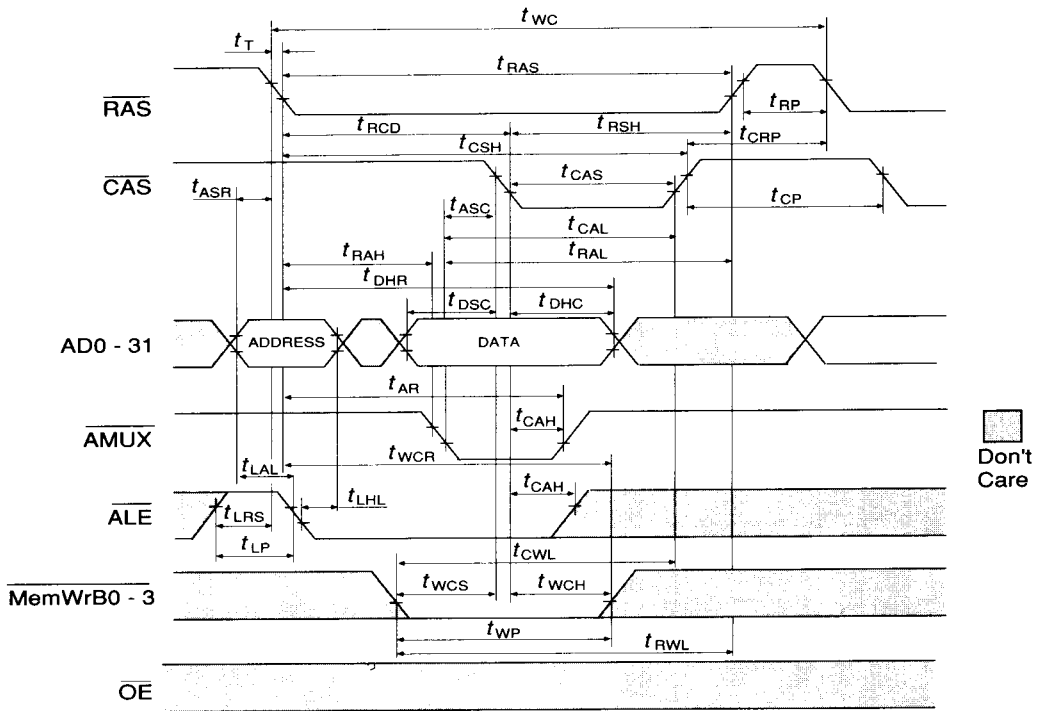
Read Cycle Timing Waveform



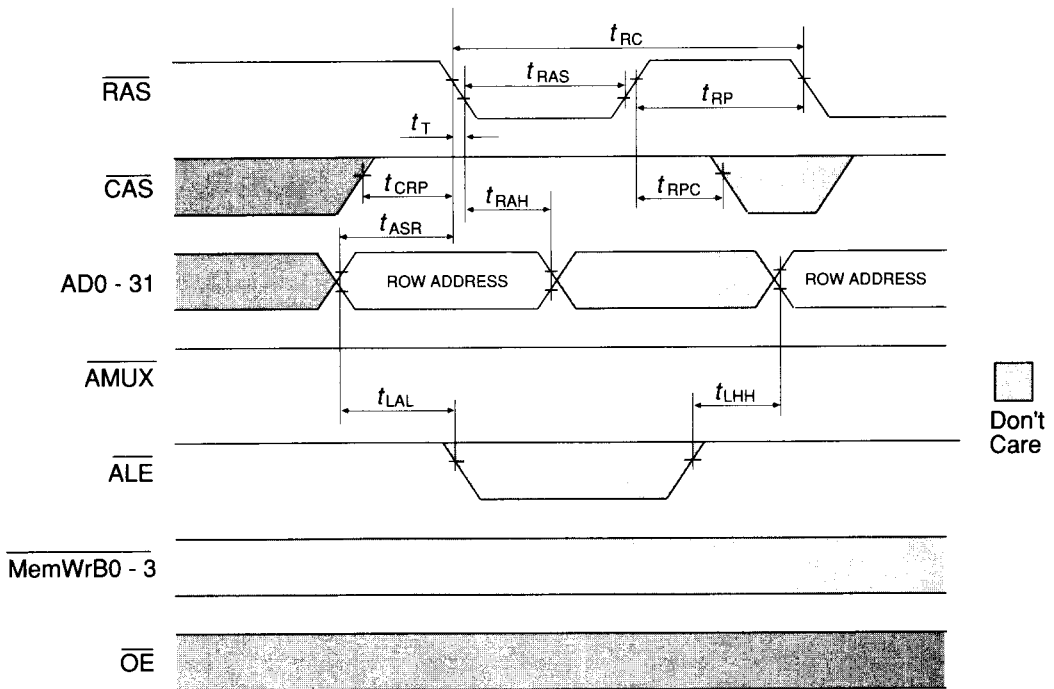
Write Cycle Timing Waveform



Early Write Cycle Timing Waveform

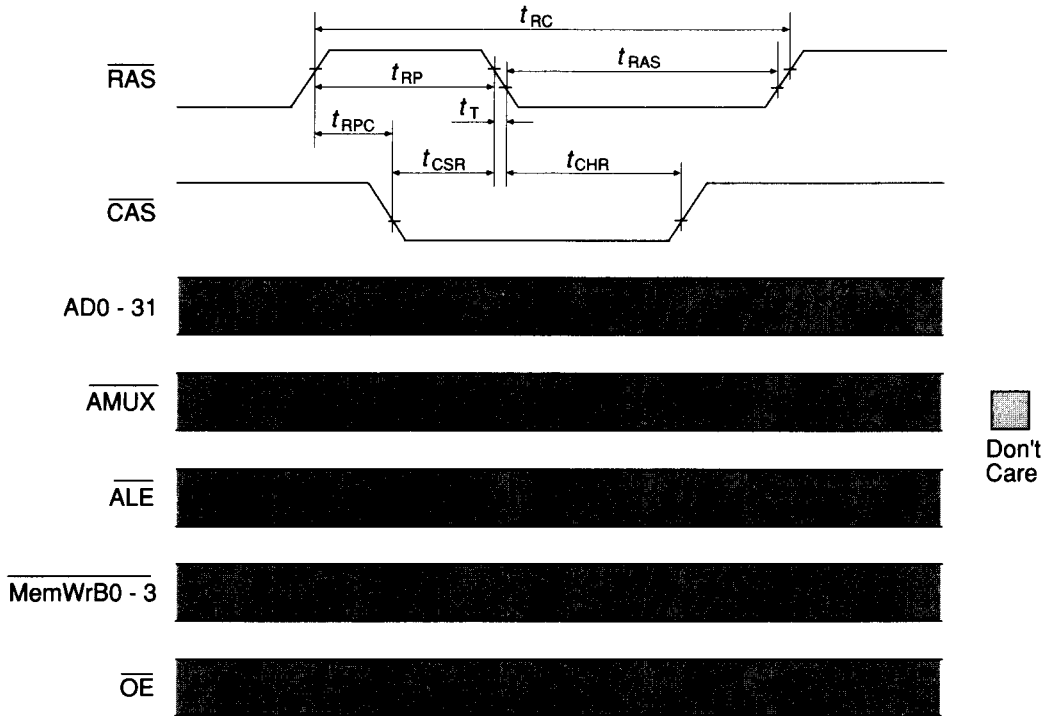


Refresh RAS Only



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Refresh CAS Before RAS



Ordering Information

MD32256FKXI-10/AD4

