

GLT44032-E

128K x 32 Embedded EDO DRAM Macro

FEATURES

- ◆ Logical organization: 128Kx32 bits
- ◆ Physical organization: 512x256x32
- ◆ Single 3.3v ± 0.3v power supply
- ◆ 512-cycle refresh in 8 ms
- ◆ Refresh modes: \overline{RAS} only, CBR, and Hidden
- ◆ Single \overline{CAS} with 4 DQM for Byte Write control
- ◆ Non-multiplex row and column addresses
- ◆ Separate I/O operation
- ◆ 80/100 MHz page mode EDO cycle

GENERAL DESCRIPTION

The GLT44032-E 4Mbit Embedded DRAM (EmDRAM) is an asynchronous design with non-multiplexed row and column addressing scheme. \overline{RAS} , \overline{CAS} , \overline{WE} and \overline{OE} control the memory operations.

Byte Write operation is controlled by $\overline{DQM}[0]$, $\overline{DQM}[1]$, $\overline{DQM}[2]$, and $\overline{DQM}[3]$. $\overline{DQM}[0]$ going LOW will mask DI[0:7] from writing into memory; $\overline{DQM}[1]$ going LOW will mask DI[8:15] from writing into memory; $\overline{DQM}[2]$ going LOW will mask DI[16:23] from writing into memory; $\overline{DQM}[3]$ going LOW will mask DI[24:31] from writing into memory. All output drivers, DO[0:31], will be Three-stated during a Write operation.

Performance Data

Parameter	-30	-35
Max. \overline{RAS} access time, t_{RAC}	30 ns	35 ns
Max. \overline{RAS} precharge time, t_{RP}	20 ns	25 ns
Max. column address access time, t_{AA}	12 ns	14 ns
Max. \overline{CAS} access time, t_{CAC}	8 ns	10 ns
Min. extended data out page mode cycle time, t_{PC}	10 ns	12.5 ns
Min. read/write cycle time, t_{RC}	60 ns	70 ns

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FUNCTIONAL BLOCK DIAGRAM

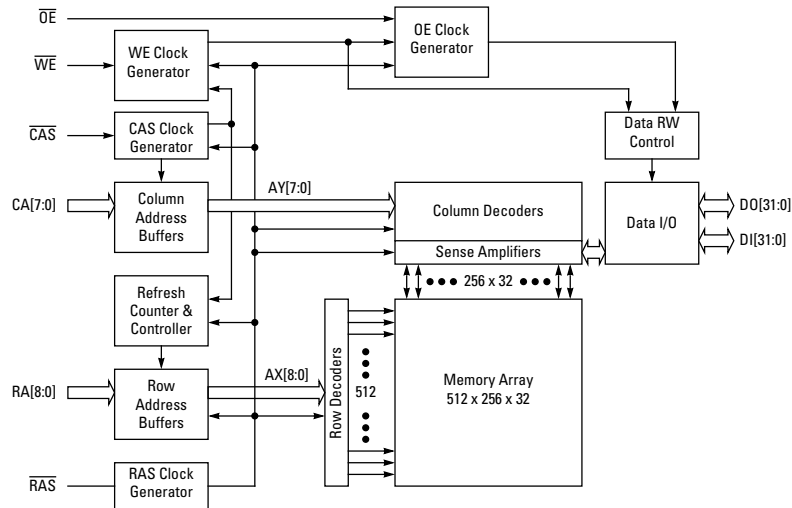


Figure 1. GLT44032-E - 128K x 32

Pin Descriptions

Symbol	Type	Description
$DI[31:0]$	Input	Data input.
$DO[31:0]$	Output	Data output.
$RA[8:0]$	Input	Row address.
$CA[7:0]$	Input	Column address.
\overline{RAS}	Input	Row address strobe.
\overline{CAS}	Input	Column address strobe.
\overline{WE}	Input	Write enable.
\overline{OE}	Input	Output enable.
$\overline{DQM}[3:0]$	I/O	Data-in mask (active low)
$V_{CC}^{[1]}$	Supply	3.3v voltage supply, 4 pairs double bond minimum
$V_{SS}^{[1]}$	Supply	Ground (voltage return), 4 pairs double bond minimum

1. V_{CC} and V_{SS} for the EmDRAM should be separated from the Logic portion of the chip.

Truth Table

Function	$\overline{\text{RAS}}$	$\overline{\text{CAS}}$	$\overline{\text{WE}}$	$\overline{\text{OE}}$	Address	DQM0	DQM1	DQM2	DQM3	DI[31:0]	DO[31:0]
Standby	H	H	X	X	X	X	X	X	X	X	High-Z
Read	L	L	H	L	Row/Col	X	X	X	X	X	Data Out
Write (Early)	L	L	L	X	Row/Col	H	H	H	H	Data In	High-Z
Write DI [7:0]	L	L	L	X	Row/Col	L	H	H	H	Data In	High-Z
Write DI [15:8]	L	L	L	X	Row/Col	H	L	H	H	Data In	High-Z
Write DI [23:16]	L	L	L	X	Row/Col	H	H	L	H	Data In	High-Z
Write DI [31:24]	L	L	L	X	Row/Col	H	H	H	L	Data In	High-Z
Read-Write	L	L	H→L	L→H	Row/Col	H	H	H	H	Data In	Data Out
Page-Mode Read (First Cycle)	L	H→L	H	L	Row/Col	X	X	X	X	X	Data Out
Page-Mode Read (Subsequent Cycles)		H→L	H	L	Col	X	X	X	X	X	Data Out
Page-Mode Write (First Cycle)	L	H→L	L	X	Row/Col	H	H	H	H	Data In	High-Z
Page-Mode Write (Subsequent Cycle)	L	H→L	L	X	Col	H	H	H	H	Data In	High-Z
Page-Mode R-W (First Cycle)	L	H→L	H→L	L→H	Row/Col	H	H	H	H	Data In	Data Out
Page-Mode R-W (Subsequent Cycle)	L	H→L	H→L	L→H	Col	H	H	H	H	Data In	Data Out
CBR Refresh	H→L	L	X	X	X	X	X	X	X	X	High-Z
RAS-only Refresh	L	H	X	X	Row	X	X	X	X	X	High-Z

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ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings ^[1]

Parameter	Rating
Ambient Operating Temperature	0 °C to +70 °C
Storage Temperature	-50 °C to +125 °C
Voltage Relative to V _{SS}	-0.5 V to 4.5 V
Power Dissipation	0.8W

1. Operation above Absolute Maximum ratings can adversely affect device reliability.

Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V _{CC}	Power Supply	3.0	3.3	3.6	V
V _{IH}	Input High Voltage	2	–	V _{CC} + 0.3	V
V _{IL}	Input Low Voltage	-0.5	–	–	V

Capacitance

Symbol	Description	Min	Max	Units	Notes
C _{IN}	Input Capacitance	–	2	pF	[1]
C _{IO}	Input/Output Capacitance	–	2	pF	[1]

1. Capacitance is sampled and not 100% tested

DC Characteristics (V_{CC} = 3.3V ±10%, T_A = 0 °C to +70 °C)

Symbol	Description	Conditions	-30		-35		Units
			Min	Max	Min	Max	
V _{IH}	Input High (Logic 1) Voltage		2.4	V _{CC} + 1	2.4	V _{CC} + 1	V
V _{IL}	Input Low (Logic 0) Voltage		-0.5	0.8	-0.5	0.8	V
V _{OH}	Output High Voltage	I _{OH} = -2.0 mA	2.4	V _{CC}	2.4	V _{CC}	V
V _{OL}	Output Low Voltage	I _{OL} = 2 mA	0	0.4	0	0.4	V
I _{CC1}	Average Power Supply Current (Operating)	$\overline{\text{RAS}}$, $\overline{\text{CAS}}$ cycling; t _{RC} = Min.	–	200	–	180	mA
I _{CC2}	Power Supply Current (Standby)	$\overline{\text{RAS}}$, $\overline{\text{CAS}} = V_{IH}$	–	1	–	1	mA
I _{CC3}	Average Power Supply Current (RAS-only Refresh)	$\overline{\text{RAS}} = \text{cycling}$; $\overline{\text{CAS}} = V_{IH}$; t _{RC} = Min.	–	200	–	180	mA
I _{CC4}	Average Power Supply Current (Fast Page Mode)	$\overline{\text{RAS}} = V_{IL}$; $\overline{\text{CAS}}$ cycling; t _{PC} = Min.	–	120	–	100	mA
I _{CC4}	Average Power Supply Current (CAS-before-RAS Refresh)	$\overline{\text{RAS}} = \text{cycling}$; $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$	–	200	–	180	mA

AC Characteristics ($V_{CC} = 3.3 V \pm 0.3 V, T_A = 0^\circ C \text{ to } +70^\circ C, C_L < 1 \text{ pF}$)

Symbol	Description	-30		-35		Units	Notes
		Min	Max	Min	Max		
t_{RC}	Random Read/Write cycle time	60	–	70	–	ns	
t_{PC}	Page Mode Read/Write cycle	10	–	12.5	–	ns	
t_{OFF}	Read Data valid from \overline{RAS} high	0	–	0	–	ns	
t_{DOH}	Read Data valid from next \overline{CAS} low	3	–	3	–	ns	
t_{AA}	Access time from Column Address	–	12	–	14	ns	[1]
t_{RAC}	Access time from \overline{RAS} low	–	30	–	35	ns	
t_{CAC}	Access time from \overline{CAS} low	–	8	–	10	ns	[1]
t_{CPA}	Access time from \overline{CAS} precharge	–	14	–	17	ns	[1]
t_{RAS}	\overline{RAS} pulse width	30	–	35	–	ns	
t_{RCD}	\overline{RAS} to \overline{CAS} delay time	15	30	18	35	ns	
t_{CAS}	\overline{CAS} pulse width	4	–	5	–	ns	
t_{ASR}	Row Address setup time	2	–	2	–	ns	
t_{RAH}	Row Address hold time	3	–	4	–	ns	
t_{ASC}	Column Address setup time	2	–	2	–	ns	
t_{CAH}	Column Address hold time	3	–	4	–	ns	
t_{CP}	\overline{CAS} precharge time	4	–	5	–	ns	
t_{CSH}	\overline{CAS} hold time from \overline{RAS}	30	–	35	–	ns	
t_{DS}	Write Data setup time	2	–	2	–	ns	
t_{DH}	Write Data hold time	3	–	4	–	ns	
t_{RP}	\overline{RAS} precharge time	20	–	25	–	ns	
t_{CRP}	\overline{CAS} to \overline{RAS} precharge time	5	–	10	–	ns	
t_{RSH}	\overline{CAS} low to \overline{RAS} high hold time	5	–	10	–	ns	
t_{RCS}	Read command setup time	3	–	5	–	ns	
t_{RCH}	Read command hold time from \overline{CAS} high	3	–	5	–	ns	
t_{RRH}	Read command hold time from \overline{RAS} high	3	–	5	–	ns	
t_{WCS}	Write command setup time	3	–	5	–	ns	
t_{WCH}	Write command hold time	3	–	5	–	ns	
t_{WP}	\overline{WE} pulse width	8	–	10	–	ns	
t_T	Transition time (rise and fall)	–	1.0	–	1.0	ns	
t_{RWL}	Write command to \overline{RAS} high	8	–	10	–	ns	
t_{CWL}	Write command to \overline{CAS} high	8	–	10	–	ns	
t_{DMS}	\overline{DQM} mask write setup time to \overline{CAS}	0	–	0	–	ns	[2]
t_{DMH}	\overline{DQM} mask write hold time from \overline{CAS}	3	–	4	–	ns	[2]
t_{ODW}	\overline{WE} control output disable	8	–	10	–	ns	

1. For better performance margin, switch column addresses and data-in on the rising edge of \overline{CAS} . Switch \overline{DQM} on the falling edge of \overline{CAS} .
2. Set-up time for \overline{DQM} to \overline{CAS} going active (low) is 0 ns; hold-time for \overline{DQM} from \overline{CAS} going non-active (high) is 4 ns. \overline{DQM} going low will mask the write.

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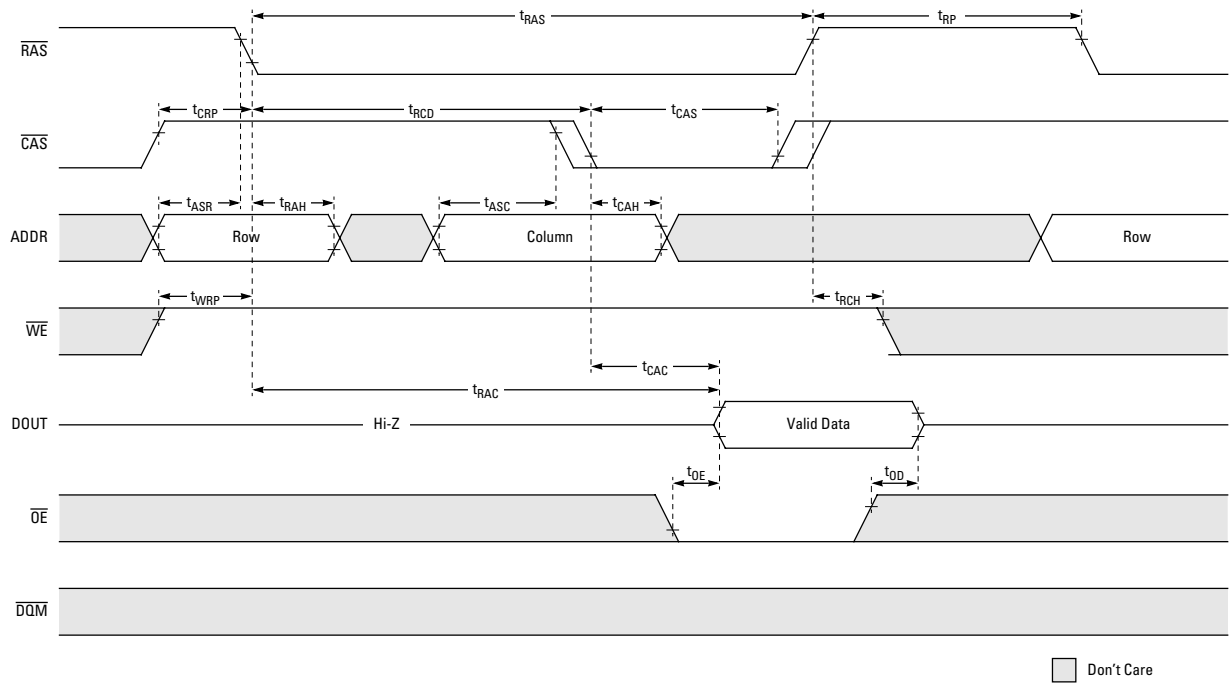


Figure 2. Read Cycle

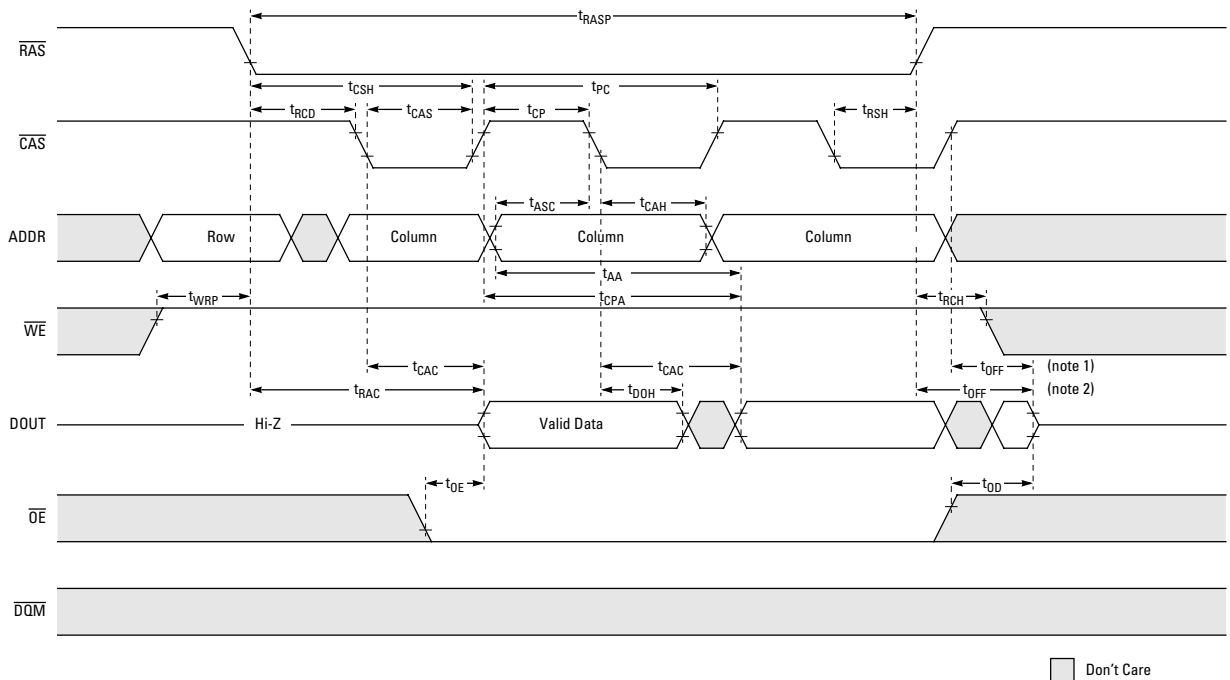


Figure 3. Page Mode Read Cycle

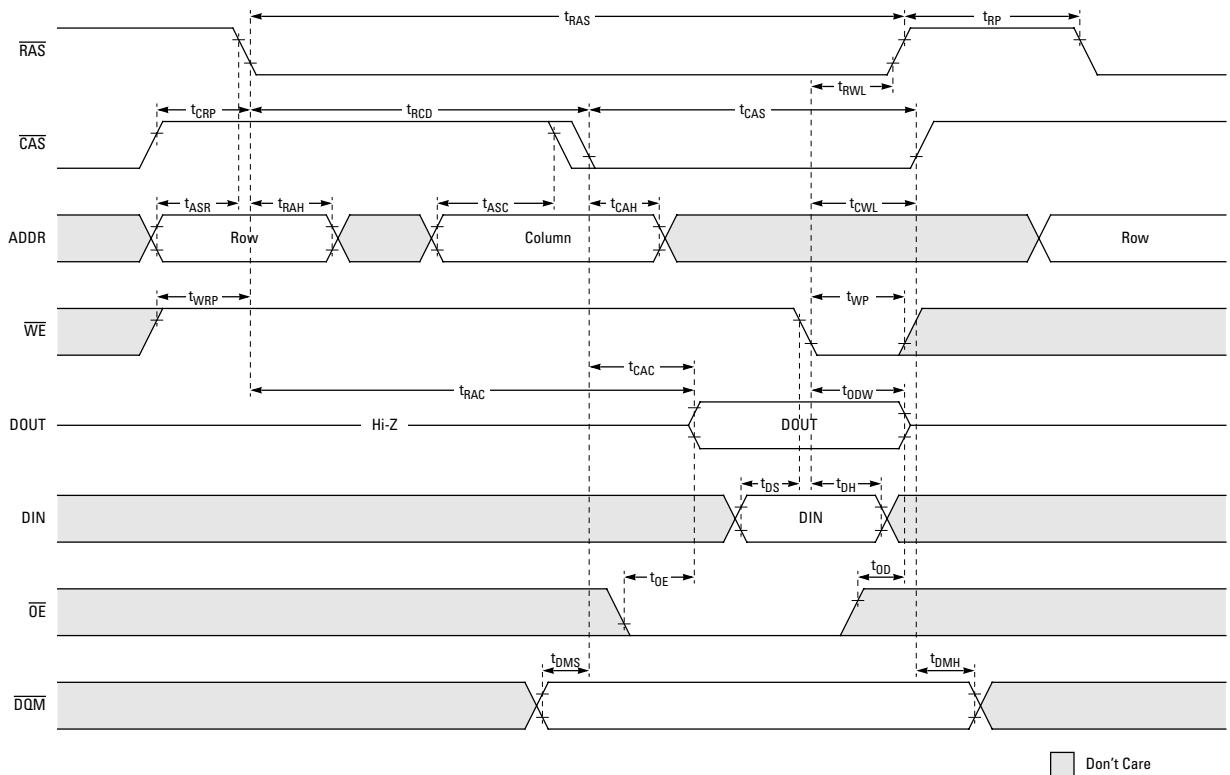


Figure 4. Read/Write Cycle

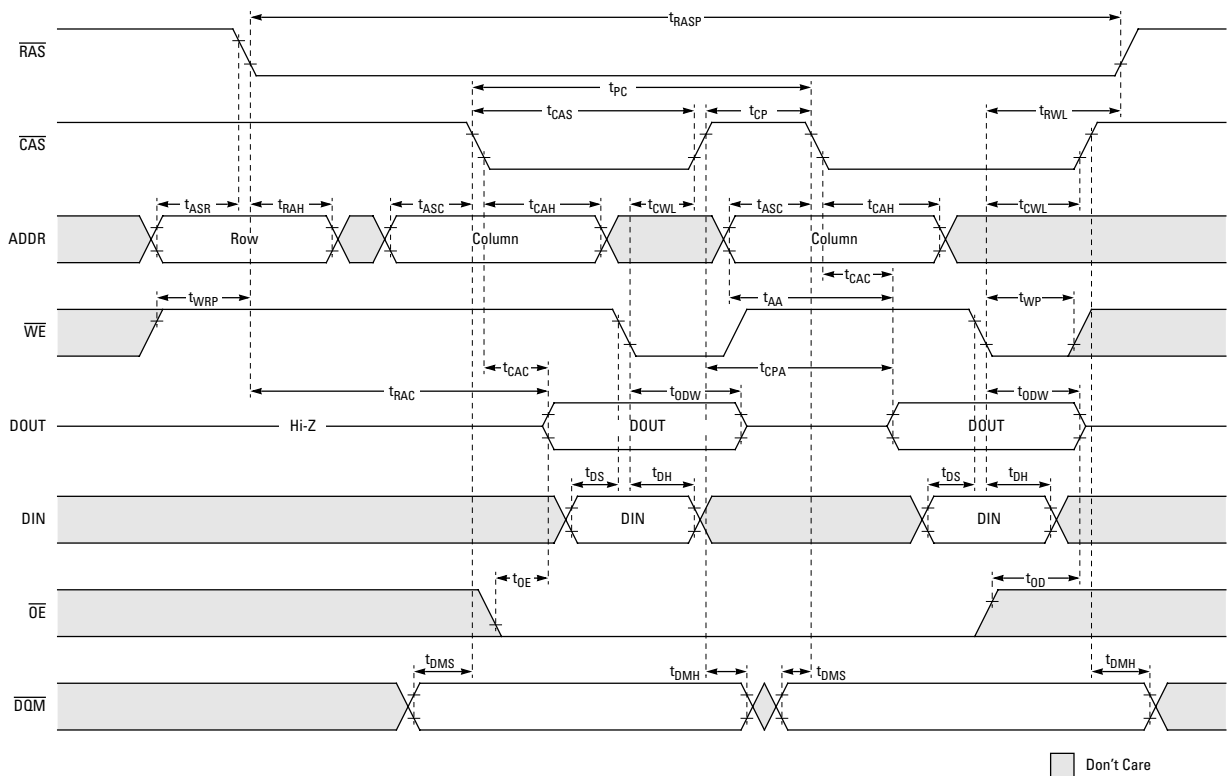


Figure 5. Page Mode Read/Write Cycle

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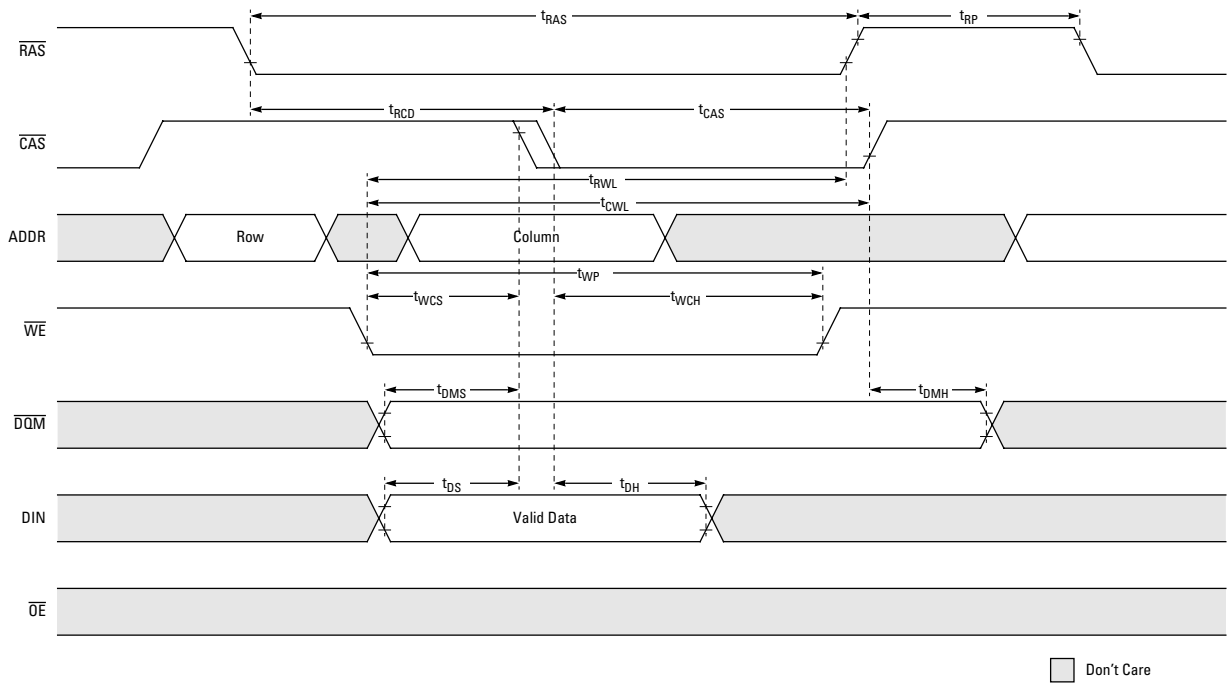


Figure 6. Early Write Cycle

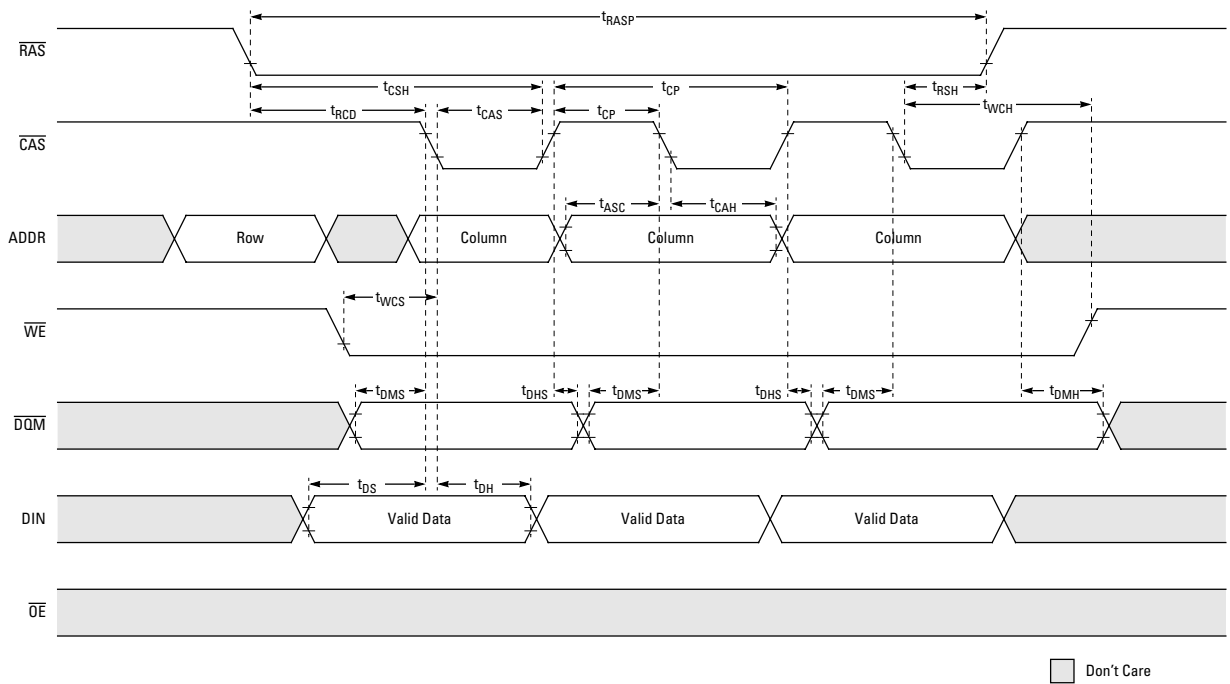


Figure 7. Page Mode Early Write Cycle

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