

DRAM MODULE

MT2D(T)132(X)

MT4D(T)232D(X)

For the latest data sheet revisions, please refer to the Micron
Web site: www.micron.com/mti/msp/html/datasheet.html

FEATURES

- JEDEC- and industry-standard pinout in a 72-pin, single in-line memory module (SIMM)
- 4MB (1 Meg x 32) and 8MB (2 Meg x 32)
- High-performance CMOS silicon-gate process
- Single +5V $\pm 10\%$ power supply
- All inputs, outputs and clocks are TTL-compatible
- Refresh modes: RAS#-ONLY, CAS#-BEFORE-RAS# (CBR) and HIDDEN
- Multiple RAS# lines allow x16 or x32 width
- 1,024-cycle refresh distributed across 16ms
- FAST PAGE MODE (FPM) access or Extended Data-Out (EDO) PAGE MODE access

OPTIONS

- Timing
 - 50ns access
 - 60ns access
- Components
 - SOJ
 - TSOP
- Packages
 - 72-pin SIMM
 - 72-pin SIMM (Gold)
- Operating Modes
 - FAST PAGE MODE
 - EDO PAGE MODE

**EDO version only

MARKING

-5**

-6

D

DT

M

G

None

X

KEY TIMING PARAMETERS

EDO Operating Mode

SPEED	t _{RC}	t _{RAC}	t _{PC}	t _{AA}	t _{CAC}	t _{CAS}
-5	84ns	50ns	20ns	25ns	15ns	8ns
-6	104ns	60ns	25ns	30ns	17ns	10ns

FPM Operating Mode

SPEED	t _{RC}	t _{RAC}	t _{PC}	t _{AA}	t _{CAC}	t _{RP}
-6	110ns	60ns	35ns	30ns	15ns	40ns

GENERAL DESCRIPTION

The MT2D(T)132(X) and MT4D(T)232D(X) are randomly accessed, 4MB and 8MB solid-state memories organized in a x32 configuration. During READ or WRITE cycles, each

PIN ASSIGNMENT (Front View)

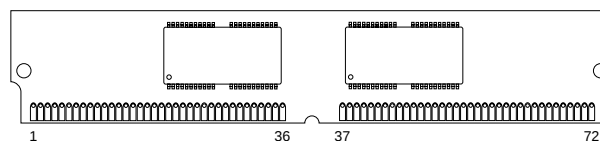
72-Pin SIMM

1 Meg x 32 – TSOP version (shown)

1 Meg x 32 – SOJ version

2 Meg x 32 – TSOP version

2 Meg x 32 – SOJ version



PIN	SYMBOL	PIN	SYMBOL	PIN	SYMBOL	PIN	SYMBOL
1	V _{SS}	19	NC (A10)	37	NC	55	DQ12
2	DQ1	20	DQ5	38	NC	56	DQ28
3	DQ17	21	DQ21	39	V _{SS}	57	DQ13
4	DQ2	22	DQ6	40	CAS0#	58	DQ29
5	DQ18	23	DQ22	41	CAS2#	59	V _{DD}
6	DQ3	24	DQ7	42	CAS3#	60	DQ30
7	DQ19	25	DQ23	43	CAS1#	61	DQ14
8	DQ4	26	DQ8	44	RAS0#	62	DQ31
9	DQ20	27	DQ24	45	NC*/RAS1#	63	DQ15
10	V _{DD}	28	A7	46	NC	64	DQ32
11	NC	29	NC (A11)	47	WE#	65	DQ16
12	A0	30	V _{DD}	48	NC	66	NC
13	A1	31	A8	49	DQ9	67	PRD1
14	A2	32	A9	50	DQ25	68	PRD2
15	A3	33	NC*/RAS3#	51	DQ10	69	PRD3
16	A4	34	RAS2#	52	DQ26	70	PRD4
17	A5	35	NC	53	DQ11	71	NC
18	A6	36	NC	54	DQ27	72	V _{SS}

*4MB version only

NOTE: Symbols in parentheses are not used on these modules but may be used for other modules in this product family. They are for reference only.

bit is uniquely addressed through 20 address bits that are entered 10 bits (A0-A9) at a time. RAS# is used to latch the first 10 bits and CAS# the latter 10 bits. A READ or WRITE cycle is selected with the WE# input. A logic HIGH on WE# dictates read mode, while a logic LOW on WE# dictates write mode. During a WRITE cycle, data-in (D) is latched by the falling edge of WE# or CAS#, whichever occurs last. EARLY WRITE occurs when WE# goes LOW prior to CAS# going LOW, and the output pin(s) remain open (High-Z) until the next CAS# cycle.

PART NUMBERS

EDO Operating Mode

PART NUMBER	CONFIGURATION	PLATING	PACKAGING
MT2DT132G-x X	1 Meg x 32	Gold	TSOP
MT2D132G-x X	1 Meg x 32	Gold	SOJ
MT2DT132M-x X	1 Meg x 32	Tin/Lead	TSOP
MT2D132M-x X	1 Meg x 32	Tin/Lead	SOJ
MT4DT232DG-x X	2 Meg x 32	Gold	TSOP
MT4D232DG-x X	2 Meg x 32	Gold	SOJ
MT4DT232DM-x X	2 Meg x 32	Tin/Lead	TSOP
MT4D232DM-x X	2 Meg x 32	Tin/Lead	SOJ

x = speed

FPM Operating Mode

PART NUMBER	CONFIGURATION	PLATING	PACKAGING
MT2DT132G-x	1 Meg x 32	Gold	TSOP
MT2D132G-x	1 Meg x 32	Gold	SOJ
MT2DT132M-x	1 Meg x 32	Tin/Lead	TSOP
MT2D132M-x	1 Meg x 32	Tin/Lead	SOJ
MT4DT232DG-x	2 Meg x 32	Gold	TSOP
MT4D232DG-x	2 Meg x 32	Gold	SOJ
MT4DT232DM-x	2 Meg x 32	Tin/Lead	TSOP
MT4D232DM-x	2 Meg x 32	Tin/Lead	SOJ

x = speed

FAST PAGE MODE

FAST-PAGE-MODE operations allow faster data operations (READ or WRITE) within a row-address-defined (A0-A9) page boundary. The FAST-PAGE-MODE cycle is always initiated with a row address strobed in by RAS# followed by a column address strobed in by CAS#. Additional columns may be accessed by providing valid column addresses, strobing CAS# and holding RAS# LOW, thus executing faster memory cycles. Returning RAS# HIGH terminates the FAST-PAGE-MODE operation.

JEDEC-DEFINED PRESENCE-DETECT – MT2D(T)132(X) (4MB)

SYMBOL	PIN	-5*	-6
PRD1	67	Vss	Vss
PRD2	68	Vss	Vss
PRD3	69	Vss	NC
PRD4	70	Vss	NC

EDO PAGE MODE

EDO PAGE MODE, designated by the “X” version, is an accelerated FAST-PAGE-MODE cycle. The primary advantage of EDO is the availability of data-out even after CAS# goes back HIGH. EDO provides for CAS# precharge time (¹CP) to occur without the output data going invalid. This elimination of CAS# output control provides for pipelined READs.

FAST-PAGE-MODE modules have traditionally turned the output buffers off (High-Z) with the rising edge of CAS#. EDO operates as any DRAM READ or FAST-PAGE-MODE READ, except data will be held valid or become valid after CAS# goes HIGH, as long as RAS# and OE# are held LOW. (Refer to the MT4LC1M16E5 DRAM data sheet for additional information on EDO functionality.)

REFRESH

Returning RAS# and CAS# HIGH terminates a memory cycle and decreases chip current to a reduced standby level. Also, the chip is preconditioned for the next cycle during the RAS# HIGH time. Memory cell data is retained in its correct state by maintaining power and executing any RAS# cycle (READ, WRITE) or RAS# REFRESH cycle (RAS#-ONLY, CBR or HIDDEN) so that all 1,024 combination of RAS# addresses (A0-A9) are executed at least every 16ms, regardless of sequence.

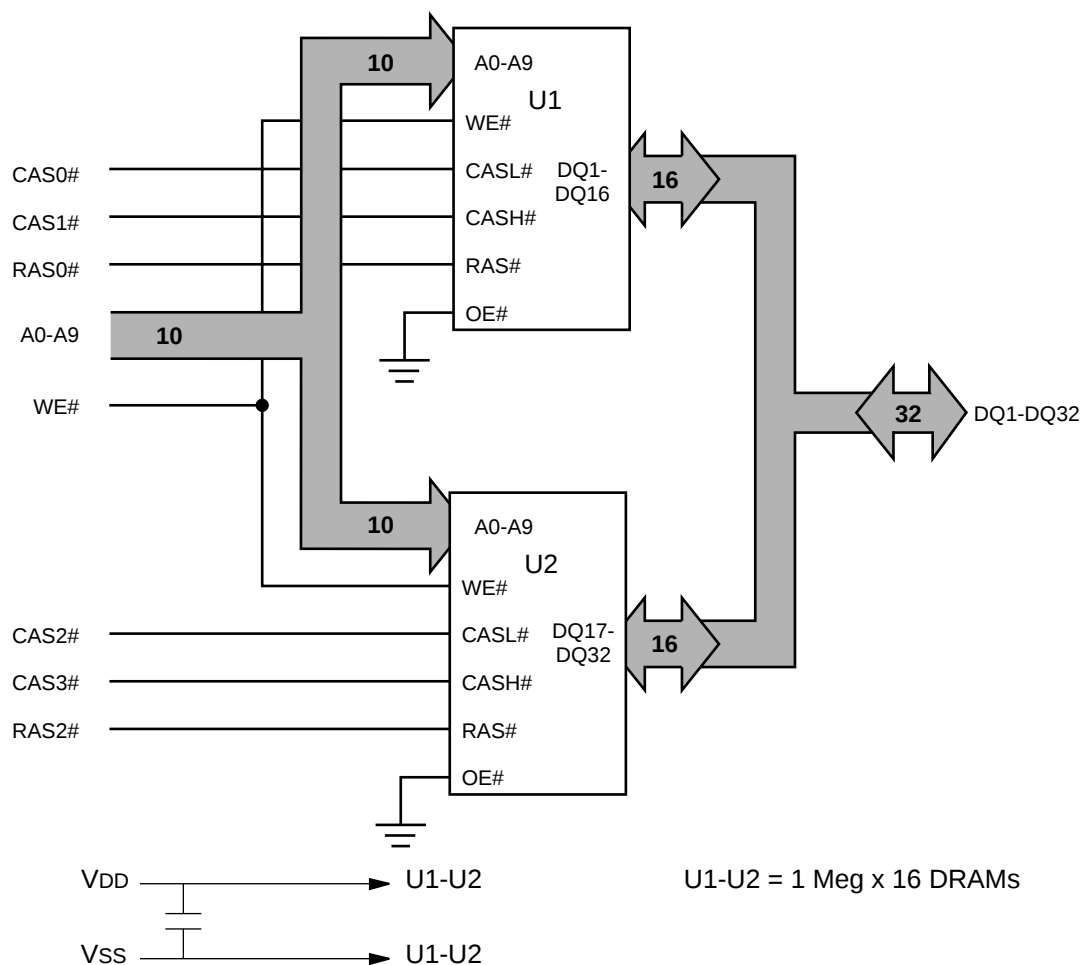
x16 CONFIGURATION

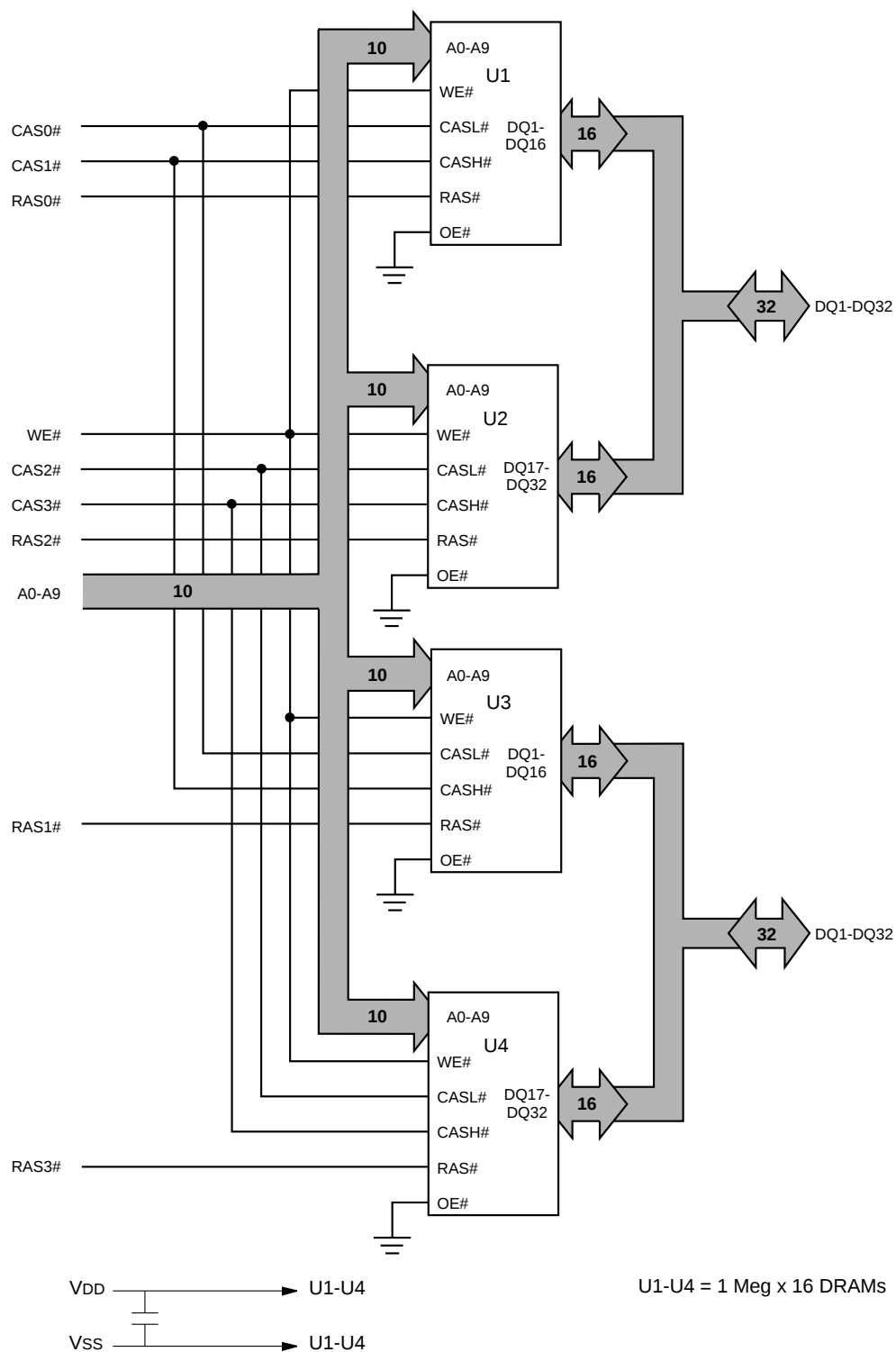
For x16 applications, the corresponding DQ and CAS# pins must be connected together (DQ1 to DQ17, DQ2 to DQ18 and so forth, and CAS0# to CAS2# and CAS1# to CAS3#). Each RAS# is then a bank select for the x16 memory organization.

JEDEC-DEFINED PRESENCE-DETECT – MT4D(T)232D(X) (8MB)

SYMBOL	PIN	-5*	-6
PRD1	67	NC	NC
PRD2	68	NC	NC
PRD3	69	Vss	NC
PRD4	70	Vss	NC

*EDO version only

**FUNCTIONAL BLOCK DIAGRAM
 MT2D(T)132(X) (4MB)**


**FUNCTIONAL BLOCK DIAGRAM
 MT4D(T)232D(X) (8MB)**


ABSOLUTE MAXIMUM RATINGS*

Voltage on V_{DD} Supply Relative to V_{SS} -1V to +7V
 Operating Temperature, T_A (ambient) 0°C to +70°C
 Storage Temperature (plastic) -55°C to +125°C
 Power Dissipation 2W
 Short Circuit Output Current 50mA

*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 above 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 AND OPERATING CONDITIONS

(Notes: 1, 3, 6) (V_{DD} = +5V ±10%)

PARAMETER/CONDITION		SYMBOL	MIN	MAX	UNITS	NOTES
SUPPLY VOLTAGE		V _{DD}	4.5	5.5	V	
INPUT HIGH VOLTAGE: Logic 1; All inputs		V _{IH}	2.4	V _{DD} + 1	V	
INPUT LOW VOLTAGE: Logic 0; All inputs		V _{IL}	-1.0	0.8	V	
INPUT LEAKAGE CURRENT: Any input 0V ≤ V _{IN} ≤ 5.5V (All other pins not under test = 0V)	CAS0#-CAS3#	I _{I1}	-4	4	μA	23
	A0-A9, WE#	I _{I2}	-8	8	μA	23
	RAS0#-RAS3#	I _{I3}	-2	2	μA	
OUTPUT LEAKAGE CURRENT: (DQ is disabled; 0V ≤ V _{OUT} ≤ 5.5V)	DQ1-DQ32	I _{OZ}	-10	10	μA	23
OUTPUT LEVELS: Output High Voltage (I _{OUT} = -5mA) Output Low Voltage (I _{OUT} = 4.2mA)		V _{OH}	2.4	–	V	
		V _{OL}	–	0.4	V	

I_{CC} SPECIFICATIONS AND CONDITIONS

(Notes: 1, 5, 6) (V_{DD} = +5V ±10%)

PARAMETER/CONDITION	SYMBOL	SIZE	MAX		UNITS	NOTES
			-5*	-6		
STANDBY CURRENT: (TTL) (RAS# = CAS# = V _{IH})	I _{CC1}	4MB	4	4	mA	
		8MB	8	8		
STANDBY CURRENT: (CMOS) (RAS# = CAS# = other inputs = V _{DD} - 0.2V)	I _{CC2}	4MB	1	1	mA	
		8MB	2	2		
OPERATING CURRENT: Random READ/WRITE Average power supply current (RAS#, CAS#, address cycling: t _{RC} = t _{RC} [MIN])	I _{CC3}	4MB	380	360	mA	2, 22
		8MB	384	364		
OPERATING CURRENT: FAST PAGE MODE Average power supply current (RAS# = V _{IL} , CAS#, address cycling: t _{PC} = t _{PC} [MIN])	I _{CC4}	4MB	—	220	mA	2, 22
		8MB	—	224		
OPERATING CURRENT: EDO PAGE MODE Average power supply current (RAS# = V _{IL} , CAS#, address cycling: t _{PC} = t _{PC} [MIN])	I _{CC5} (X only)	4MB	300	280	mA	2, 22
		8MB	304	284		
REFRESH CURRENT: RAS#-ONLY Average power supply current (RAS# cycling, CAS# = V _{IH} : t _{RC} = t _{RC} [MIN])	I _{CC6}	4MB	380	360	mA	2
		8MB	384	364		
REFRESH CURRENT: CBR Average power supply current (RAS#, CAS#, address cycling: t _{RC} = t _{RC} [MIN])	I _{CC7}	4MB	360	340	mA	2, 17
		8MB	364	344		

*EDO version only

CAPACITANCE

PARAMETER	SYMBOL	MAX		UNITS	NOTES
		4MB	8MB		
Input Capacitance: A0-A9	C _{I1}	16	26	pF	15
Input Capacitance: WE#	C _{I2}	20	34	pF	15
Input Capacitance: RAS0#-RAS3#	C _{I3}	10	10	pF	15
Input Capacitance: CAS0#-CAS3#	C _{I4}	10	20	pF	15
Input/Output Capacitance: DQ1-DQ32	C _{IO}	10	18	pF	15

FAST PAGE MODE

AC ELECTRICAL CHARACTERISTICS

(Notes: 3, 4, 5, 6, 7, 8, 9, 14) (V_{DD} = +5V ±10%)

AC CHARACTERISTICS - FAST PAGE MODE OPTION		-6		UNITS	NOTES
PARAMETER	SYMBOL	MIN	MAX		
Access time from column address	t _{AA}		30	ns	
Column-address hold time (referenced to RAS#)	t _{AR}	45		ns	
Column-address setup time	t _{ASC}	0		ns	
Row-address setup time	t _{ASR}	0		ns	
Access time from CAS#	t _{CAC}		15	ns	
Column-address hold time	t _{CAH}	10		ns	
CAS# pulse width	t _{CAS}	15	10,000	ns	
CAS# hold time (CBR Refresh)	t _{CHR}	15		ns	17
Last CAS# going LOW to first CAS# to return HIGH	t _{CLCH}	10		ns	
CAS# to output in Low-Z	t _{CLZ}	3		ns	21
CAS# precharge time	t _{CP}	10		ns	16
Access time from CAS# precharge	t _{CPA}		35	ns	
CAS# to RAS# precharge time	t _{CRP}	5		ns	
CAS# hold time	t _{CSH}	60		ns	
CAS# setup time (CBR Refresh)	t _{CSR}	5		ns	17
WRITE command to CAS# lead time	t _{CWL}	15		ns	
Data-in hold time	t _{DH}	10		ns	13
Data-in setup time	t _{DS}	0		ns	13
Output buffer turn-off delay	t _{OFF}	3	15	ns	10, 24
FAST-PAGE-MODE READ or WRITE cycle time	t _{PC}	35		ns	
Access time from RAS#	t _{RAC}		60	ns	
RAS# to column-address delay time	t _{RAD}	15		ns	20
Row-address hold time	t _{RAH}	10		ns	
RAS# pulse width	t _{RAS}	60	10,000	ns	
RAS# pulse width (FAST PAGE MODE)	t _{RASP}	60	125,000	ns	
Random READ or WRITE cycle time	t _{RC}	110		ns	
RAS# to CAS# delay time	t _{RCD}	20		ns	11
READ command hold time (referenced to CAS#)	t _{RCH}	0		ns	12
READ command setup time	t _{RCS}	0		ns	
Refresh period (1,024 cycles)	t _{REF}		16	ms	
RAS# precharge time	t _{RP}	40		ns	
RAS# to CAS# precharge time	t _{RPC}	0		ns	
READ command hold time	t _{RRH}	0		ns	12

FAST PAGE MODE
AC ELECTRICAL CHARACTERISTICS

 (Notes: 3, 4, 5, 6, 7, 8, 9, 14) ($V_{DD} = +5V \pm 10\%$)

AC CHARACTERISTICS - FAST PAGE MODE OPTION		-6			
PARAMETER	SYMBOL	MIN	MAX	UNITS	NOTES
RAS# hold time	t_{RSH}	15		ns	
WRITE command to RAS# lead time	t_{RWL}	15		ns	
Transition time (rise or fall)	t_T	2	50	ns	
WRITE command hold time	t_{WCH}	10		ns	
WRITE command hold time (referenced to RAS#)	t_{WCR}	45		ns	
WE# command setup time	t_{WCS}	0		ns	
WRITE command pulse width	t_{WP}	10		ns	
WE# hold time (CBR Refresh)	t_{WRH}	10		ns	
WE# setup time (CBR Refresh)	t_{WRP}	10		ns	

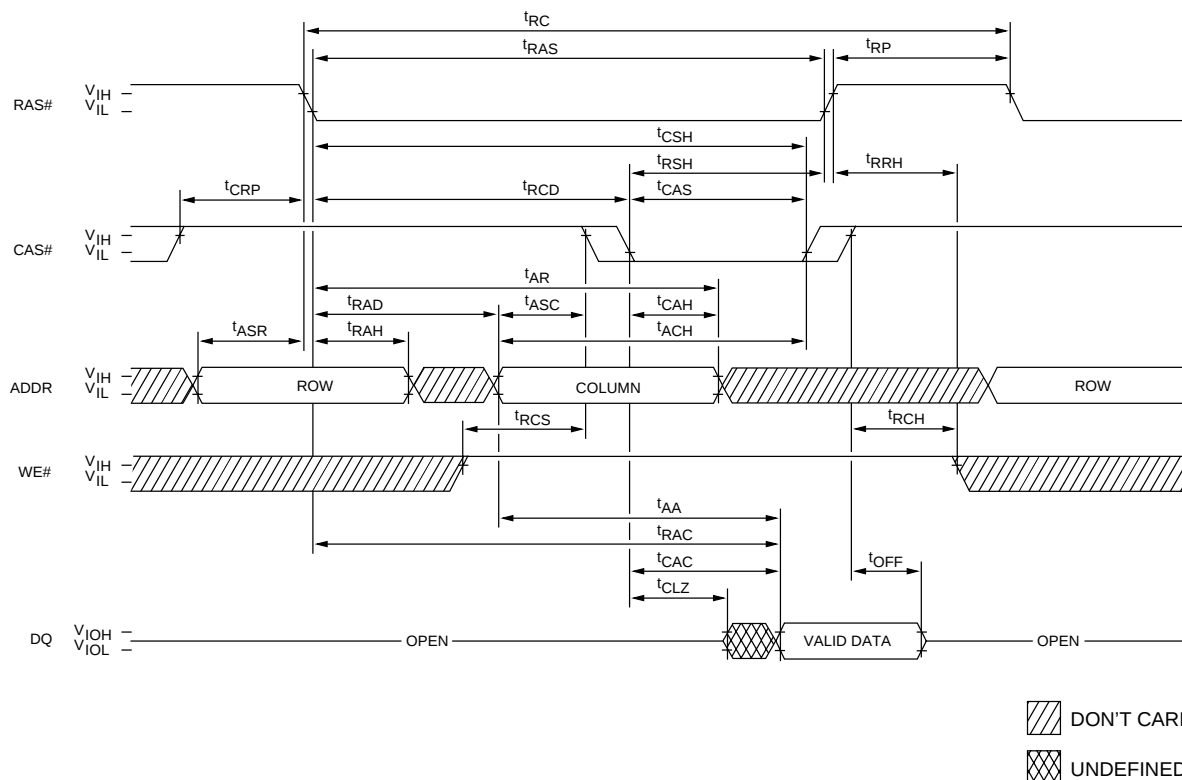
EDO PAGE MODE
AC ELECTRICAL CHARACTERISTICS

 (Notes: 3, 4, 5, 6, 7, 8, 9, 14) ($V_{DD} = +5V \pm 10\%$)*

AC CHARACTERISTICS - EDO PAGE MODE OPTION		-5		-6		UNITS	NOTES
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX		
Access time from column address	t_{AA}		25		30	ns	
Column-address set-up to CAS# precharge	t_{ACH}	12		15		ns	
Column-address hold time (referenced to RAS#)	t_{AR}	38		45		ns	
Column-address setup time	t_{ASC}	0		0		ns	
Row-address setup time	t_{ASR}	0		0		ns	
Access time from CAS#	t_{CAC}		15		17	ns	
Column-address hold time	t_{CAH}	8		10		ns	
CAS# pulse width	t_{CAS}	8	10,000	10	10,000	ns	
CAS# hold time (CBR Refresh)	t_{CHR}	8		10		ns	17
CAS# to output in Low-Z	t_{CLZ}	0		0		ns	
Data output hold after next CAS# LOW	t_{COH}	3		3		ns	
CAS# precharge time	t_{CP}	8		10		ns	16
Access time from CAS# precharge	t_{CPA}		28		35	ns	
CAS# to RAS# precharge time	t_{CRP}	5		5		ns	
CAS# hold time	t_{CSH}	38		45		ns	
CAS# setup time (CBR Refresh)	t_{CSR}	5		5		ns	17
WRITE command to CAS# lead time	t_{CWL}	8		10		ns	
Data-in hold time	t_{DH}	8		10		ns	13
Data-in setup time	t_{DS}	0		0		ns	13
Output buffer turn-off delay	t_{OFF}	0	12	0	15	ns	10, 24
EDO-PAGE-MODE READ or WRITE cycle time	t_{PC}	20		25		ns	
Access time from RAS#	t_{RAC}		50		60	ns	
RAS# to column-address delay time	t_{RAD}	9		12		ns	20
Row-address hold time	t_{RAH}	9		10		ns	
RAS# pulse width	t_{RAS}	50	10,000	60	10,000	ns	
RAS# pulse width (EDO PAGE MODE)	t_{RASP}	50	125,000	60	125,000	ns	
Random READ or WRITE cycle time	t_{RC}	84		104		ns	
RAS# to CAS# delay time	t_{RCD}	11		14		ns	11
READ command hold time (referenced to CAS#)	t_{RCH}	0		0		ns	12
READ command setup time	t_{RCS}	0		0		ns	
Refresh period (1,024 cycles)	t_{REF}		16		16	ms	
RAS# precharge time	t_{RP}	30		40		ns	
RAS# to CAS# precharge time	t_{RPC}	5		5		ns	
READ command hold time (referenced to RAS#)	t_{RRH}	0		0		ns	12
RAS# hold time	t_{RSH}	13		15		ns	
WRITE command to RAS# lead time	t_{RWL}	13		15		ns	
Transition time (rise or fall)	t_T	2	50	2	50	ns	
WRITE command hold time	t_{WCH}	8		10		ns	
WRITE command hold time (referenced to RAS#)	t_{WCR}	38		45		ns	
WE# command setup time	t_{WCS}	0		0		ns	
Output disable delay from WE#	t_{WHZ}	0	12	0	15	ns	
WRITE command pulse width	t_{WP}	5		5		ns	
WE# pulse to disable at CAS# HIGH	t_{WPZ}	10		10		ns	
WE# hold time (CBR Refresh)	t_{WRH}	8		10		ns	
WE# setup time (CBR Refresh)	t_{WRP}	8		10		ns	

NOTES

1. All voltages referenced to V_{SS} .
2. I_{CC} is dependent on output loading and cycle rates. Specified values are obtained with minimum cycle time and the output open.
3. An initial pause of 100 μ s is required after power-up, followed by eight RAS# refresh cycles (RAS#-ONLY or CBR with WE# HIGH), before proper device operation is ensured. The eight RAS# cycle wake-ups should be repeated any time the t_{REF} refresh requirement is exceeded.
4. AC characteristics assume $t_T = 5$ ns for FPM and $t_T = 2.5$ ns for EDO.
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} or between V_{IL} and V_{IH} .
6. The minimum specifications are used only to indicate cycle time at which proper operation over the full temperature range ($0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$) is ensured.
7. Measured with a load equivalent to two TTL gates and 100pF, $V_{OL} = 0.8$ V and $V_{OH} = 2$ V.
8. If CAS# = V_{IH} , data output is High-Z.
9. If CAS# = V_{IL} , data output may contain data from the last valid READ cycle.
10. t_{OFF} (MAX) defines the time at which the output achieves the open circuit condition and is not referenced to V_{OH} or V_{OL} .
11. The t_{RCD} (MAX) limit is no longer specified. t_{RCD} (MAX) was specified as a reference point only. If t_{RCD} was greater than the specified t_{RCD} (MAX) limit, then access time was controlled exclusively by t_{CAC} (t_{RAC} [MIN] no longer applied). With or without the t_{RCD} (MAX) limit, t_{AA} and t_{CAC} must always be met.
12. Either t_{RCH} or t_{RRH} must be satisfied for a READ cycle.
13. These parameters are referenced to CAS# leading edge in EARLY WRITE cycles.
14. In addition to meeting the transition rate specification, all input signals must transit between V_{IH} and V_{IL} (or between V_{IL} and V_{IH}) in a monotonic manner.
15. This parameter is sampled. Capacitance is measured using MIL-STD-883C, Method 3012.1 (1 MHz AC, $V_{DD} = 4.5$ V, DC bias = 2.4V at 15mV RMS).
16. If CAS# is LOW at the falling edge of RAS#, data-out (Q) will be maintained from the previous cycle. To initiate a new cycle and clear the data-out buffer, CAS# must be pulsed HIGH for t_{CP} .
17. On-chip refresh and address counters are enabled.
18. A HIDDEN REFRESH may also be performed after a WRITE cycle. In this case, WE# = LOW.
19. LATE WRITE, READ-WRITE or READ-MODIFY-WRITE cycles are not available due to OE# being grounded on U1-U2/U4.
20. The t_{RAD} (MAX) limit is no longer specified. t_{RAD} (MAX) was specified as a reference point only. If t_{RAD} was greater than the specified t_{RAD} (MAX) limit, then access time was controlled exclusively by t_{AA} (t_{RAC} and t_{CAC} no longer applied). With or without the t_{RAD} (MAX) limit, t_{AA} , t_{RAC} and t_{CAC} must always be met.
21. The 3ns minimum is a parameter guaranteed by design.
22. Column address changed once each cycle.
23. 4MB module values will be half of those shown.
24. For the FPM option, t_{OFF} is determined by the first RAS# or CAS# signal to transition HIGH. In comparison, t_{OFF} on an EDO option is determined by the latter of the RAS# and CAS# signals to transition HIGH.
25. Applies to both EDO and FPM modules.

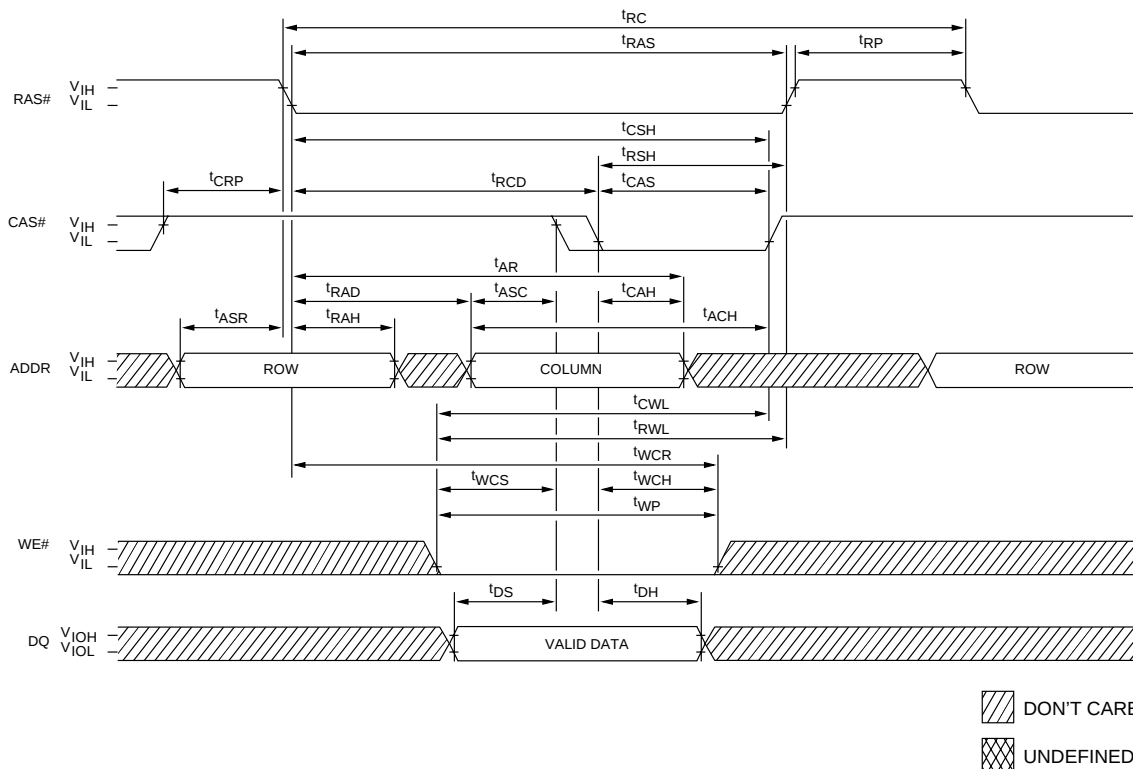
READ CYCLE ²⁵

**FAST PAGE MODE AND EDO PAGE MODE
 TIMING PARAMETERS**

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{AA}		25		30	ns
t _{ACH} (EDO)	12		15		ns
t _{AR}	38		45		ns
t _{ASC}	0		0		ns
t _{ASR}	0		0		ns
t _{CAC}		15		17	ns
t _{CAH}	8		10		ns
t _{CAS} (EDO)	8	10,000	10	10,000	ns
t _{CAS} (FPM)	—	—	15	10,000	ns
t _{CLZ} (EDO)	0		0		ns
t _{CLZ} (FPM)	—		3		ns
t _{CRP}	5		5		ns
t _{CSH} (EDO)	38		45		ns
t _{CSH} (FPM)	—		60		ns
t _{OFF} (EDO)	0	12	0	15	ns

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{OFF} (FPM)	—	—	3	15	ns
t _{RAC}		50		60	ns
t _{RAD} (EDO)	9		12		ns
t _{RAD} (FPM)	—		15		ns
t _{RAH}	9		10		ns
t _{RAS}	50	10,000	60	10,000	ns
t _{RC} (EDO)	84		104		ns
t _{RC} (FPM)	—		110		ns
t _{RCD} (EDO)	11		14		ns
t _{RCD} (FPM)	—		20		ns
t _{RCH}	0		0		ns
t _{RCS}	0		0		ns
t _{RP}	30		40		ns
t _{RRH}	0		0		ns
t _{RSH}	13		15		ns

*EDO version only

NOTE: 1. For EDO, t_{OFF} is referenced from rising edge of RAS# or CAS#, whichever occurs last. For FPM, t_{OFF} is referenced from rising edge of RAS# or CAS#, whichever occurs first.

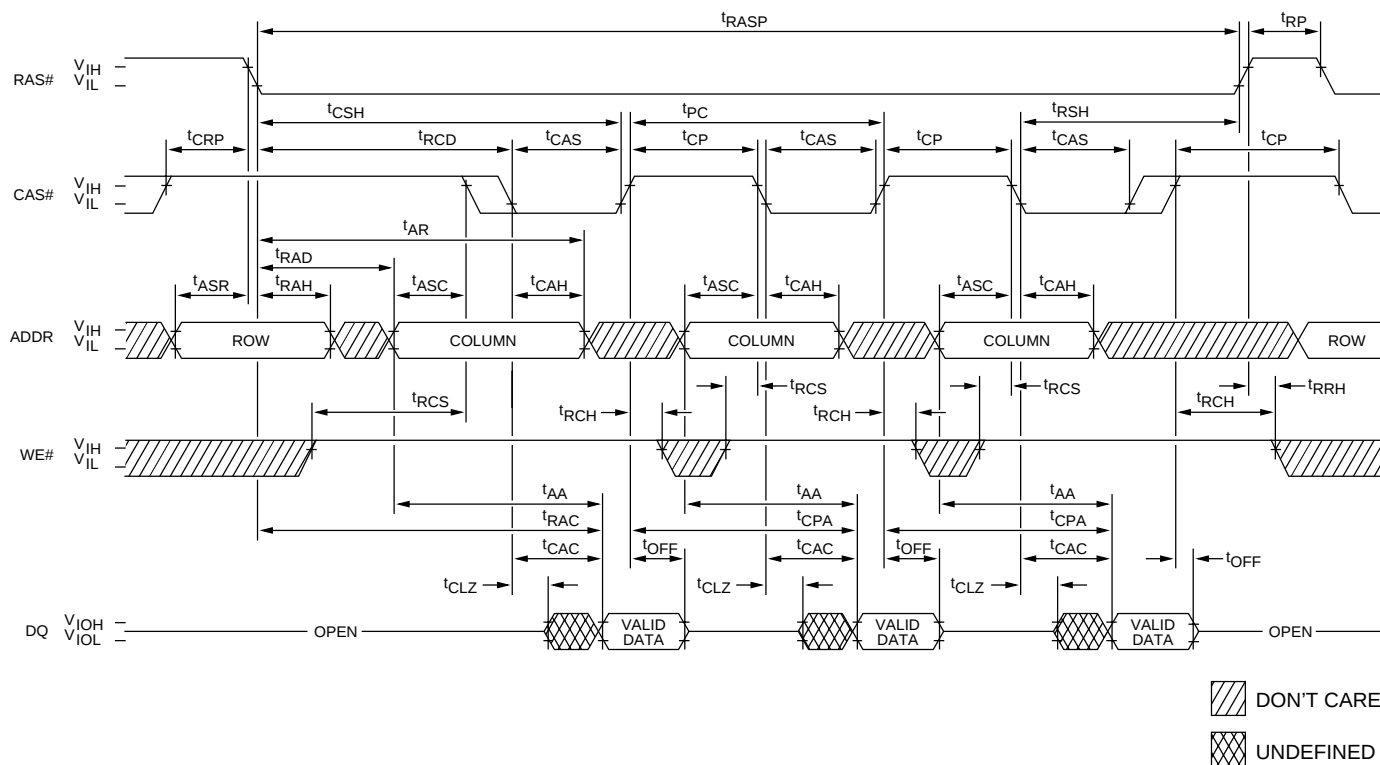
EARLY WRITE CYCLE ²⁵

**FAST PAGE MODE AND EDO PAGE MODE
 TIMING PARAMETERS**

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t_{ACH} (EDO)	12		15		ns
t_{AR}	38		45		ns
t_{ASC}	0		0		ns
t_{ASR}	0		0		ns
t_{CAH}	8		10		ns
t_{CAS} (FPM)	—	—	15	10,000	ns
t_{CAS} (EDO)	8	10,000	10	10,000	ns
t_{CRP}	5		5		ns
t_{CSH} (FPM)	—		60		ns
t_{CSH} (EDO)	38		45		ns
t_{CWL} (FPM)	—		15		ns
t_{CWL} (EDO)	8		10		ns
t_{DH}	8		10		ns
t_{DS}	0		0		ns
t_{RAD} (FPM)	—		15		ns

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t_{RAD} (EDO)	9		12		ns
t_{RAH}	9		10		ns
t_{RAS}	50	10,000	60	10,000	ns
t_{RC} (FPM)	—		110		ns
t_{RC} (EDO)	84		104		ns
t_{RCD} (FPM)	—		20		ns
t_{RCD} (EDO)	11		14		ns
t_{RP}	30		40		ns
t_{RSH}	13		15		ns
t_{RWL}	13		15		ns
t_{WCH}	8		10		ns
t_{WCR}	38		45		ns
t_{WCS}	0		0		ns
t_{WP} (FPM)	—		10		ns
t_{WP} (EDO)	5		5		ns

*EDO version only

FAST-PAGE-MODE READ CYCLE

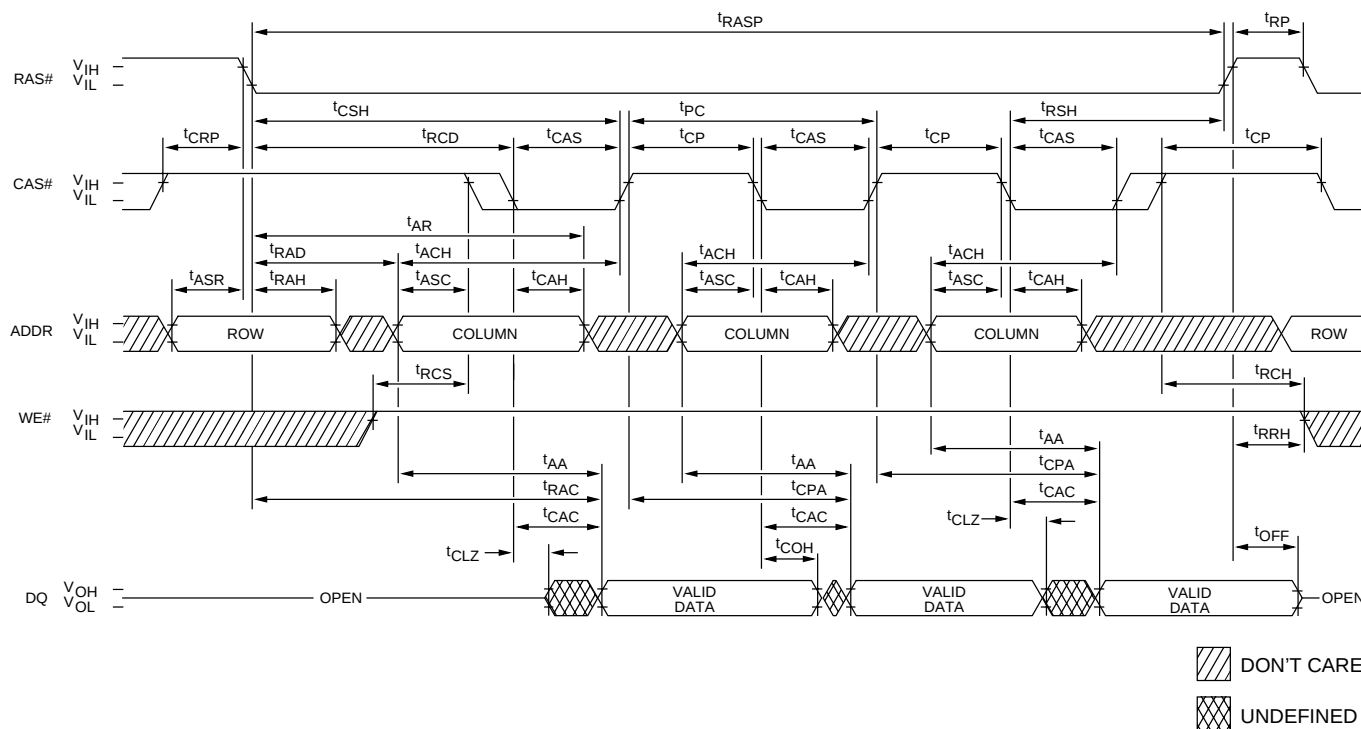


FAST PAGE MODE TIMING PARAMETERS

SYMBOL	-6		UNITS
	MIN	MAX	
t _{AA}		30	ns
t _{AR}	45		ns
t _{ASC}	0		ns
t _{ASR}	0		ns
t _{CAC}		15	ns
t _{CAH}	10		ns
t _{CAS}	15	10,000	ns
t _{CLZ}	3		ns
t _{CP}	10		ns
t _{CPA}		35	ns
t _{CRP}	5		ns
t _{CSH}	60		ns

SYMBOL	-6		UNITS
	MIN	MAX	
t _{OFF}	3	15	ns
t _{PC}	35		ns
t _{RAC}		60	ns
t _{RAD}	15		ns
t _{RAH}	10		ns
t _{RASP}	60	125,000	ns
t _{RCD}	20		ns
t _{RCH}	0		ns
t _{RCS}	0		ns
t _{RP}	40		ns
t _{RRH}	0		ns
t _{RSH}	15		ns

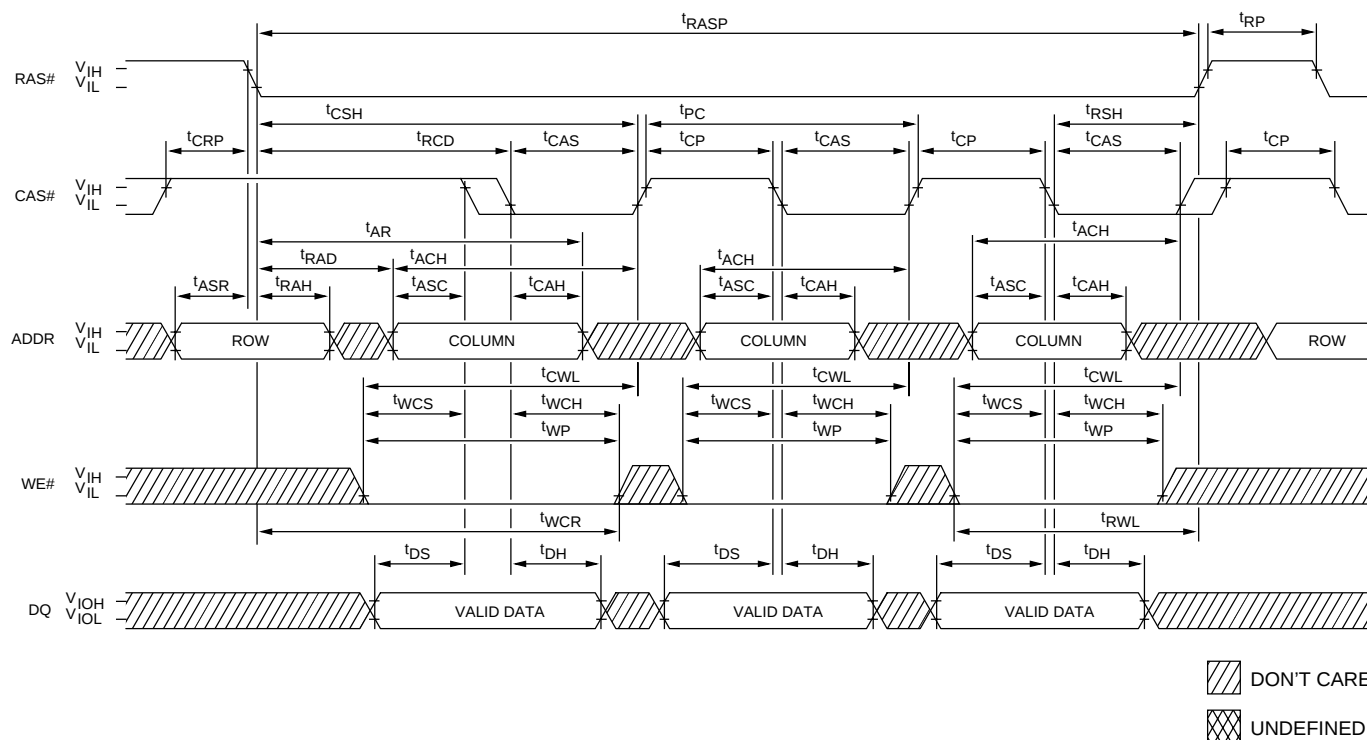
EDO-PAGE-MODE READ CYCLE



EDO PAGE MODE TIMING PARAMETERS

SYMBOL	-5		-6		UNITS
	MIN	MAX	MIN	MAX	
t_{AA}		25		30	ns
t_{ACH}	12		15		ns
t_{AR}	38		45		ns
t_{ASC}	0		0		ns
t_{ASR}	0		0		ns
t_{CAC}		15		17	ns
t_{CAH}	8		10		ns
t_{CAS}	8	10,000	10	10,000	ns
t_{CLZ}	0		0		ns
t_{COH}	3		3		ns
t_{CP}	8		10		ns
t_{CPA}		28		35	ns
t_{CRP}	5		5		ns

SYMBOL	-5		-6		UNITS
	MIN	MAX	MIN	MAX	
t_{CSH}	38		45		ns
t_{OFF}	0	12	0	15	ns
t_{PC}	20		25		ns
t_{RAC}		50		60	ns
t_{RAD}	9		12		ns
t_{RAH}	9		10		ns
t_{RASP}	50	125,000	60	125,000	ns
t_{RCD}	11		14		ns
t_{RCH}	0		0		ns
t_{RCS}	0		0		ns
t_{RP}	30		40		ns
t_{RRH}	0		0		ns
t_{RSH}	13		15		ns

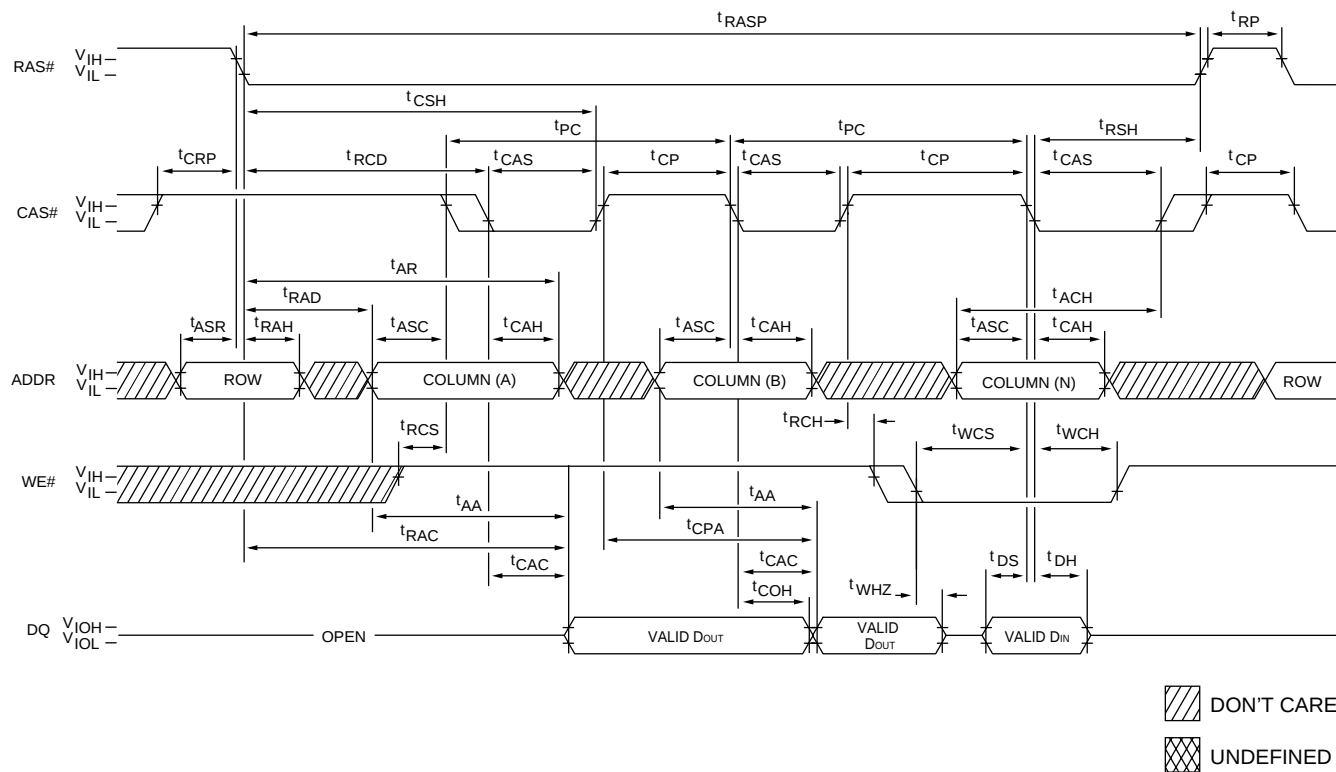
FAST/EDO-PAGE-MODE EARLY-WRITE CYCLE ²⁵

**FAST PAGE MODE AND EDO PAGE MODE
 TIMING PARAMETERS**

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{ACH} (EDO)	12		15		ns
t _{AR}	38		45		ns
t _{ASC}	0		0		ns
t _{ASR}	0		0		ns
t _{CAH}	8		10		ns
t _{CAS} (EDO)	8	10,000	10	10,000	ns
t _{CAS} (FPM)	—	—	15	10,000	ns
t _{CP}	8		10		ns
t _{CRP}	5		5		ns
t _{CSH} (EDO)	38		45		ns
t _{CSH} (FPM)	—		60		ns
t _{CWL} (EDO)	8		10		ns
t _{CWL} (FPM)	—		15		ns
t _{DH}	8		10		ns
t _{DS}	0		0		ns
t _{PC} (EDO)	20		25		ns

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{PC} (FPM)	—		35		ns
t _{RAD} (EDO)	9		12		ns
t _{RAD} (FPM)	—		15		ns
t _{RAH}	9		10		ns
t _{RASP}	50	125,000	60	125,000	ns
t _{RCD} (EDO)	11		14		ns
t _{RCD} (FPM)	—		20		ns
t _{RP}	30		40		ns
t _{RSH}	13		15		ns
t _{RWL}	13		15		ns
t _{WCH}	8		10		ns
t _{WCR}	38		45		ns
t _{WCS}	0		0		ns
t _{WP} (EDO)	5		5		ns
t _{WP} (FPM)	—		10		ns

*EDO version only

EDO-PAGE-MODE READ-EARLY-WRITE CYCLE (Pseudo READ-MODIFY-WRITE)

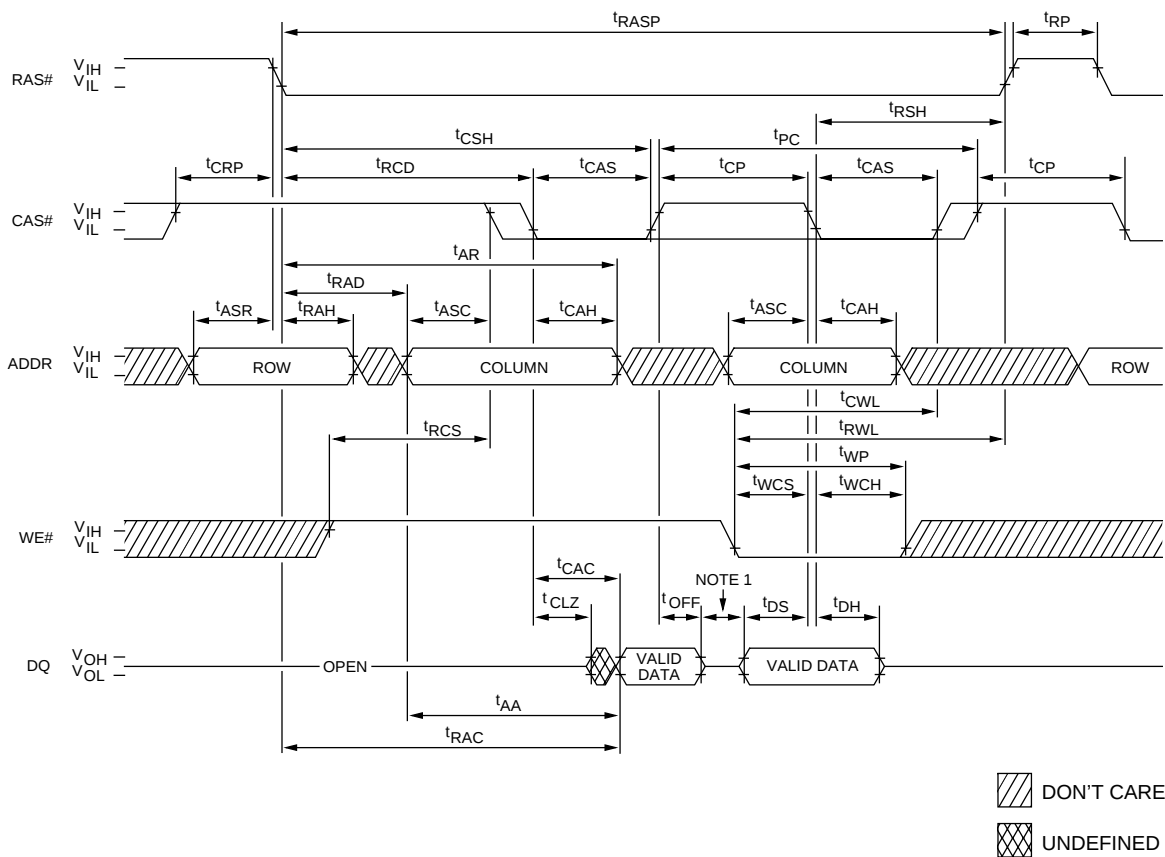


EDO PAGE MODE TIMING PARAMETERS

SYMBOL	-5		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{AA}		25		30	ns
t _{ACH}	12		15		ns
t _{AR}	38		45		ns
t _{ASC}	0		0		ns
t _{ASR}	0		0		ns
t _{CAC}		15		17	ns
t _{CAH}	8		10		ns
t _{CAS}	8	10,000	10	10,000	ns
t _{COH}	3		3		ns
t _{CP}	8		10		ns
t _{CPA}		28		35	ns
t _{CRP}	5		5		ns
t _{CSH}	38		45		ns
t _{DH}	8		10		ns

SYMBOL	-5		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{DS}	0		0		ns
t _{PC}	20		25		ns
t _{RAC}		50		60	ns
t _{RAD}	9		12		ns
t _{RAH}	9		10		ns
t _{RASP}	50	125,000	60	125,000	ns
t _{RCD}	11		14		ns
t _{RCH}	0		0		ns
t _{RCS}	0		0		ns
t _{RP}	30		40		ns
t _{RSH}	13		15		ns
t _{WCH}	8		10		ns
t _{WCS}	0		0		ns
t _{WHZ}	0	12	0	15	ns

FAST-PAGE-MODE READ-EARLY-WRITE CYCLE (Pseudo READ-MODIFY-WRITE)



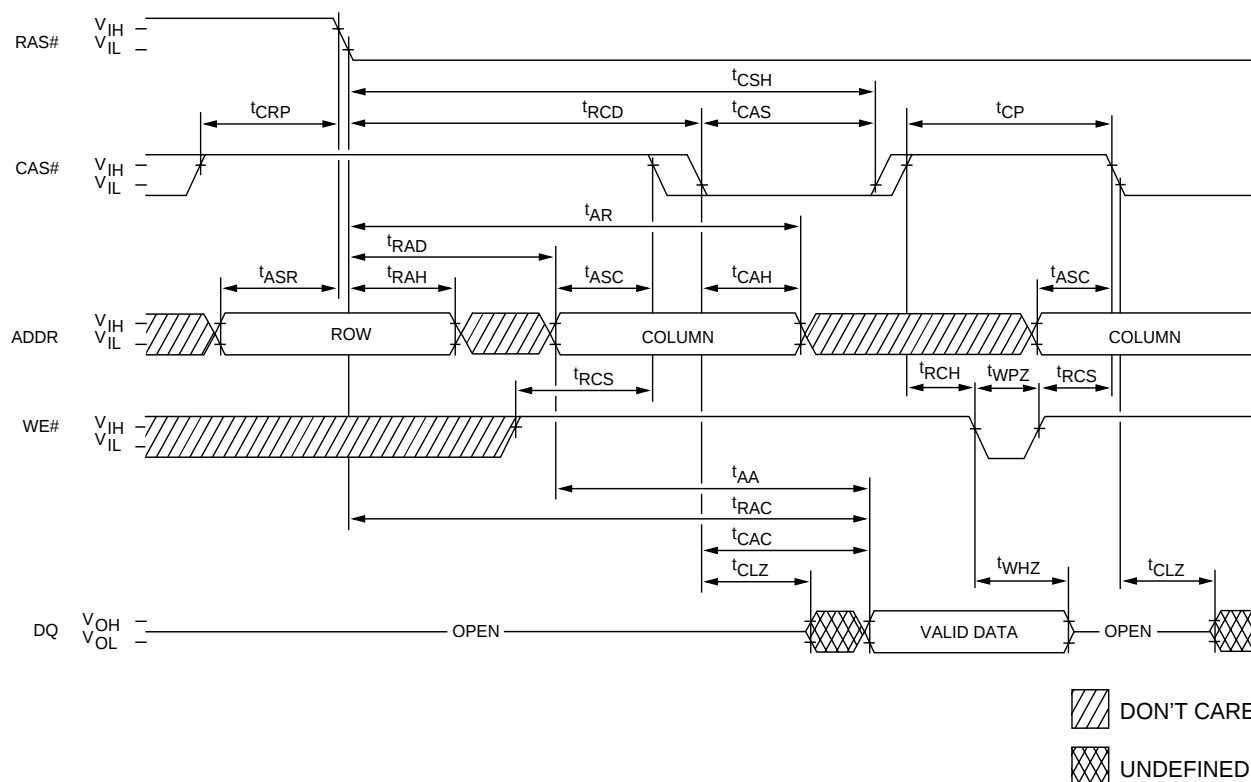
FAST PAGE MODE TIMING PARAMETERS

SYMBOL	-6		UNITS
	MIN	MAX	
^t AA		30	ns
^t AR	45		ns
^t ASC	0		ns
^t ASR	0		ns
^t CAC		15	ns
^t CAH	10		ns
^t CAS	15	10,000	ns
^t CLZ	3		ns
^t CP	10		ns
^t CRP	5		ns
^t CSH	60		ns
^t CWL	15		ns
^t DH	10		ns
^t DS	0		ns

SYMBOL	-6		UNITS
	MIN	MAX	
^t OFF	3	15	ns
^t PC	35		ns
^t RAC		60	ns
^t RAD	15		ns
^t RAH	10		ns
^t RASP	60	125,000	ns
^t RCD	20		ns
^t RCS	0		ns
^t RP	40		ns
^t RSH	15		ns
^t RWL	15		ns
^t WCH	10		ns
^t WCS	0		ns
^t WP	10		ns

NOTE: 1. Do not drive data prior to tristate.

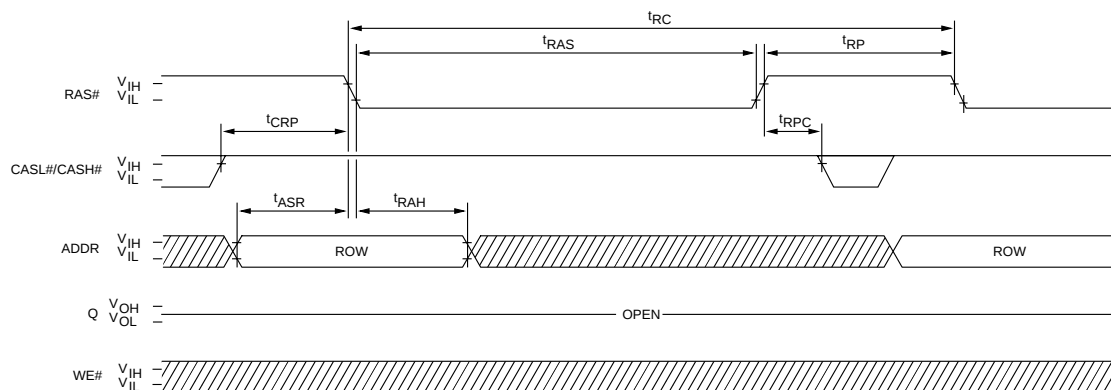
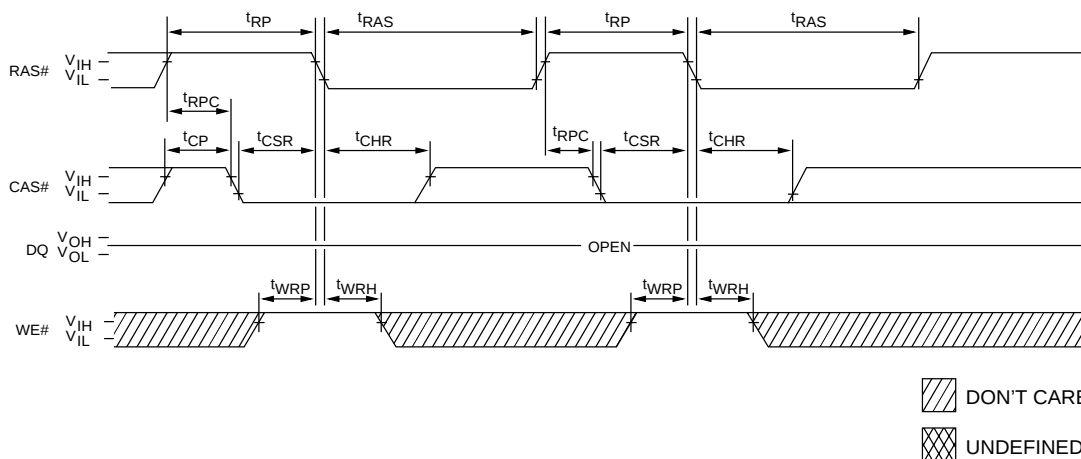
EDO READ CYCLE (with WE#-controlled disable)



EDO PAGE MODE TIMING PARAMETERS

SYMBOL	-5		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{AA}		25		30	ns
t _{AR}	38		45		ns
t _{ASC}	0		0		ns
t _{ASR}	0		0		ns
t _{CAC}		15		17	ns
t _{CAH}	8		10		ns
t _{CAS}	8	10,000	10	10,000	ns
t _{CLZ}	0		0		ns
t _{CP}	8		10		ns
t _{CRP}	5		5		ns

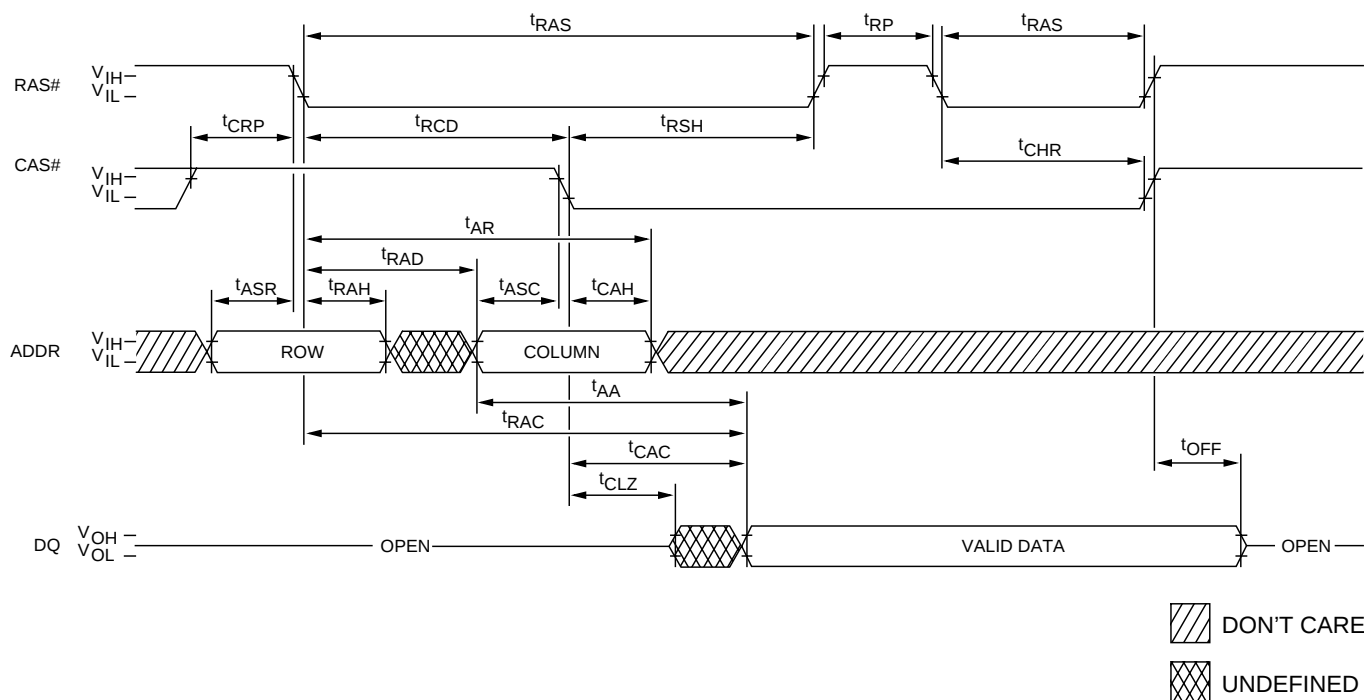
SYMBOL	-5		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{CSH}	38		45		ns
t _{RAC}		50		60	ns
t _{RAD}	9		12		ns
t _{RAH}	9		10		ns
t _{RCD}	11		14		ns
t _{RCH}	0		0		ns
t _{RCS}	0		0		ns
t _{WHZ}	0	12	0	15	ns
t _{WPZ}	10		10		ns

RAS#-ONLY REFRESH CYCLE ²⁵

CBR REFRESH CYCLE ²⁵
 (Addresses = DON'T CARE)

**FAST PAGE MODE AND EDO PAGE MODE
 TIMING PARAMETERS**

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{ASR}	0		0		ns
t _{CHR}	8		10		ns
t _{CP}	8		10		ns
t _{CRP}	5		5		ns
t _{CSR}	5		5		ns
t _{RAH}	9		10		ns
t _{RAS}	50	10,000	60	10,000	ns

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{RC} (FPM)	—		110		ns
t _{RC} (EDO)	84		104		ns
t _{RP}	30		40		ns
t _{RPC} (FPM)	—		0		ns
t _{RPC} (EDO)	5		5		ns
t _{WRH}	8		10		ns
t _{WRP}	8		10		ns

*EDO version only

HIDDEN REFRESH CYCLE ^{18, 25}
 (WE# = HIGH)

**FAST PAGE MODE AND EDO PAGE MODE
 TIMING PARAMETERS**

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{AA}		25		30	ns
t _{AR}	38		45		ns
t _{ASC}	0		0		ns
t _{ASR}	0		0		ns
t _{CAC}		15		17	ns
t _{CAH}	8		10		ns
t _{CHR} (FPM)	—		15		ns
t _{CHR} (EDO)	8		10		ns
t _{CLZ} (FPM)	—		3		ns
t _{CLZ} (EDO)	0		0		ns
t _{CRP}	5		5		ns

SYMBOL	-5*		-6		UNITS
	MIN	MAX	MIN	MAX	
t _{OFF} (FPM)	—	—	3	15	ns
t _{OFF} (EDO)	0	12	0	15	ns
t _{RAC}		50		60	ns
t _{RAD} (FPM)	—		15		ns
t _{RAD} (EDO)	9		12		ns
t _{RAH}	9		10		ns
t _{RAS}	50	10,000	60	10,000	ns
t _{RCD} (FPM)	—		20		ns
t _{RCD} (EDO)	11		14		ns
t _{RP}	30		40		ns
t _{RSH}	13		15		ns

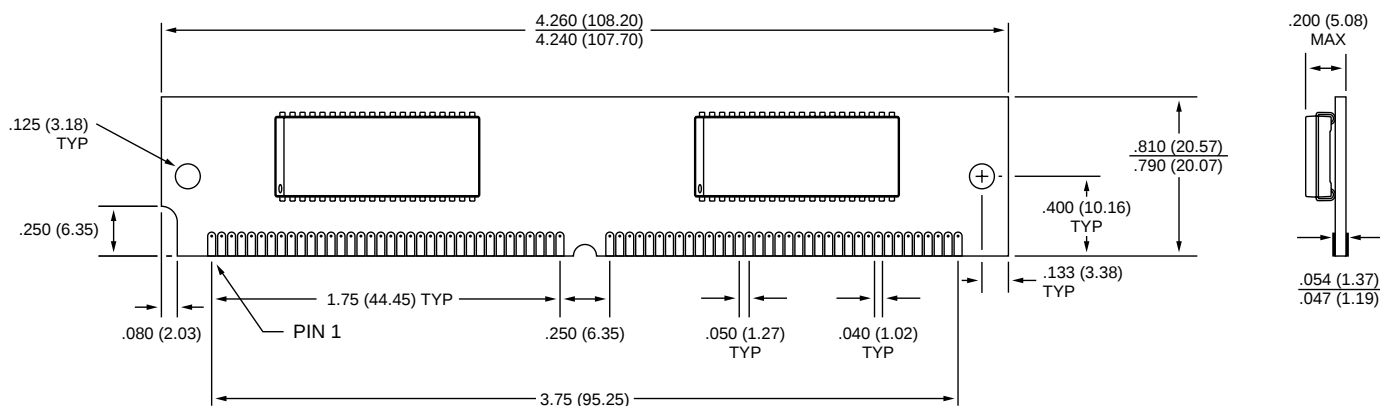
*EDO version only

OBSOLETE

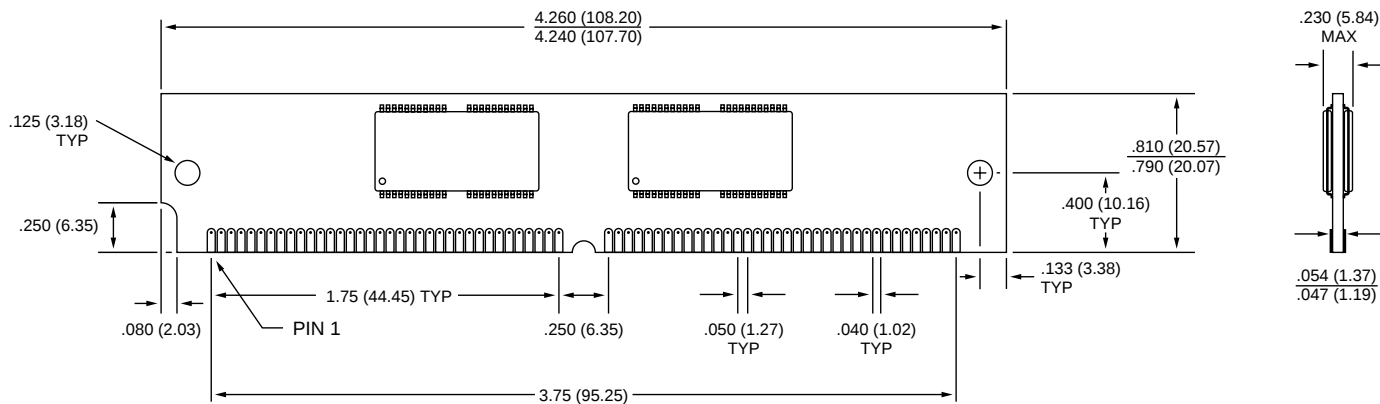
MICRON
TECHNOLOGY, INC.

**1, 2 MEG x 32
DRAM SIMMs**

**72-Pin SIMM
(4MB)**



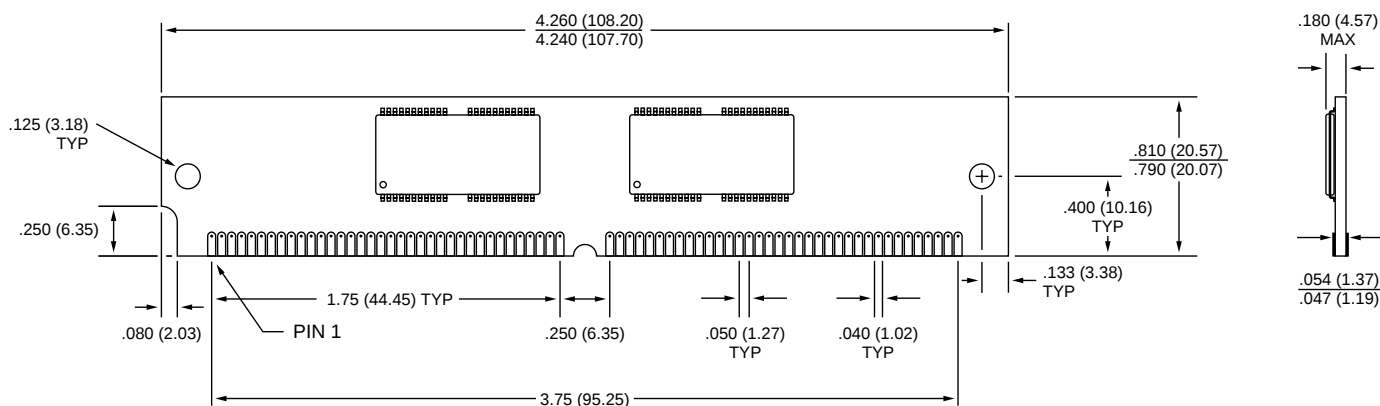
**72-Pin SIMM
(8MB)**



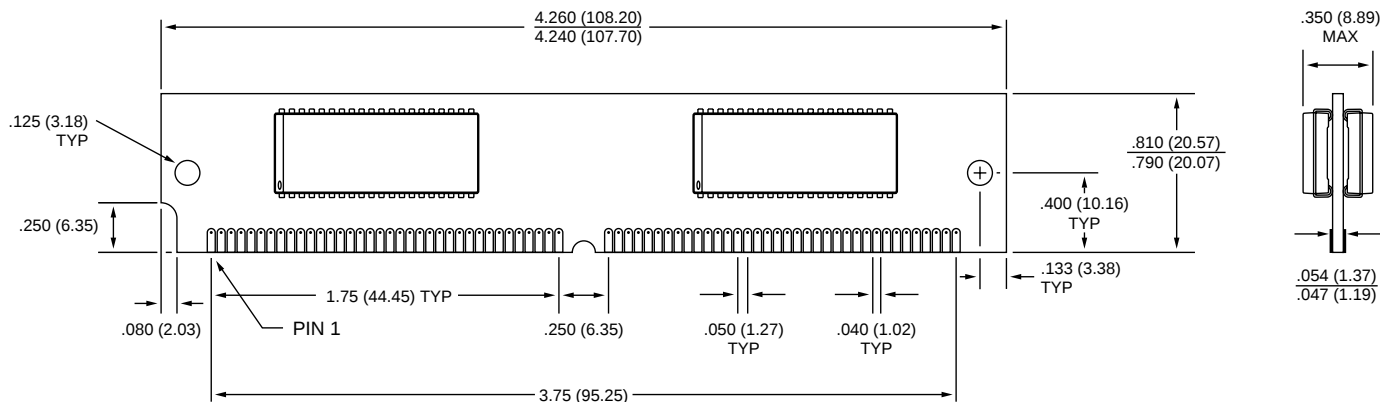
NOTE: 1. All dimensions in inches (millimeters) $\frac{\text{MAX}}{\text{MIN}}$ or typical where noted.

MICRON[®]
TECHNOLOGY INC.

72-Pin SIMM (4MB)



**72-Pin SIMM
(8MB)**



NOTE: 1. All dimensions in inches (millimeters) $\frac{\text{MAX}}{\text{MIN}}$ or typical where noted.

MICRON[®]
TECHNOLOGY, INC.

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