

DRAM MODULE

MT8D132(X)
MT16D232(X)

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) operating mode or Extended Data-Out (EDO) PAGE MODE operating mode

OPTIONS

- Timing
60ns access
- Packages
72-pin SIMM
72-pin SIMM (gold)
- Operating Modes
FAST PAGE MODE
EDO PAGE MODE

MARKING

-6

M
GBlank
X

PART NUMBERS

EDO Operating Mode

PART NUMBER	CONFIGURATION	PLATING
MT8D132G-xx X	1 Meg x 32	Gold
MT8D132M-xx X	1 Meg x 32	Tin/Lead
MT16D232G-xx X	2 Meg x 32	Gold
MT16D232M-xx X	2 Meg x 32	Tin/Lead

xx = speed

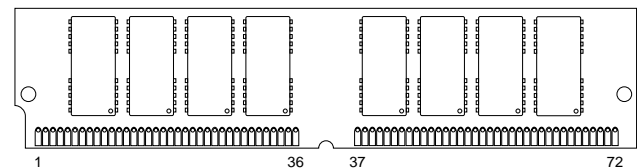
FPM Operating Mode

PART NUMBER	CONFIGURATION	PLATING
MT8D132G-xx	1 Meg x 32	Gold
MT8D132M-xx	1 Meg x 32	Tin/Lead
MT16D232G-xx	2 Meg x 32	Gold
MT16D232M-xx	2 Meg x 32	Tin/Lead

xx = speed

PIN ASSIGNMENT (Front View)

72-Pin SIMM
(DD-3) 1 Meg x 32
(DD-4) 2 Meg x 32



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 _{CC}
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 _{CC}	28	A7	46	NC	64	DQ32
11	NC	29	NC (A11)	47	WE#	65	DQ16
12	A0	30	V _{CC}	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.

KEY TIMING PARAMETERS

EDO Operating Mode

SPEED	t _{RC}	t _{RAC}	t _{PC}	t _{AA}	t _{CAC}	t _{CAS}
-6	110ns	60ns	26ns	30ns	17ns	13ns

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 MT8D132(X) and MT16D232(X) are randomly accessed 4MB and 8MB solid-state memories organized in a x32 configuration. During READ or WRITE cycles, each bit is uniquely addressed through the 20 address bits, which 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.

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#. CAS# may be toggled-in by holding RAS# LOW and strobing-in different column addresses, thus executing faster memory cycles. Returning RAS# HIGH terminates the FAST PAGE MODE operation.

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 pipeline 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 after CAS# goes HIGH, as long as RAS# and OE# are held LOW and WE# is held HIGH. (Reference MT4C4007J DRAM data sheet for additional information on EDO functionality.)

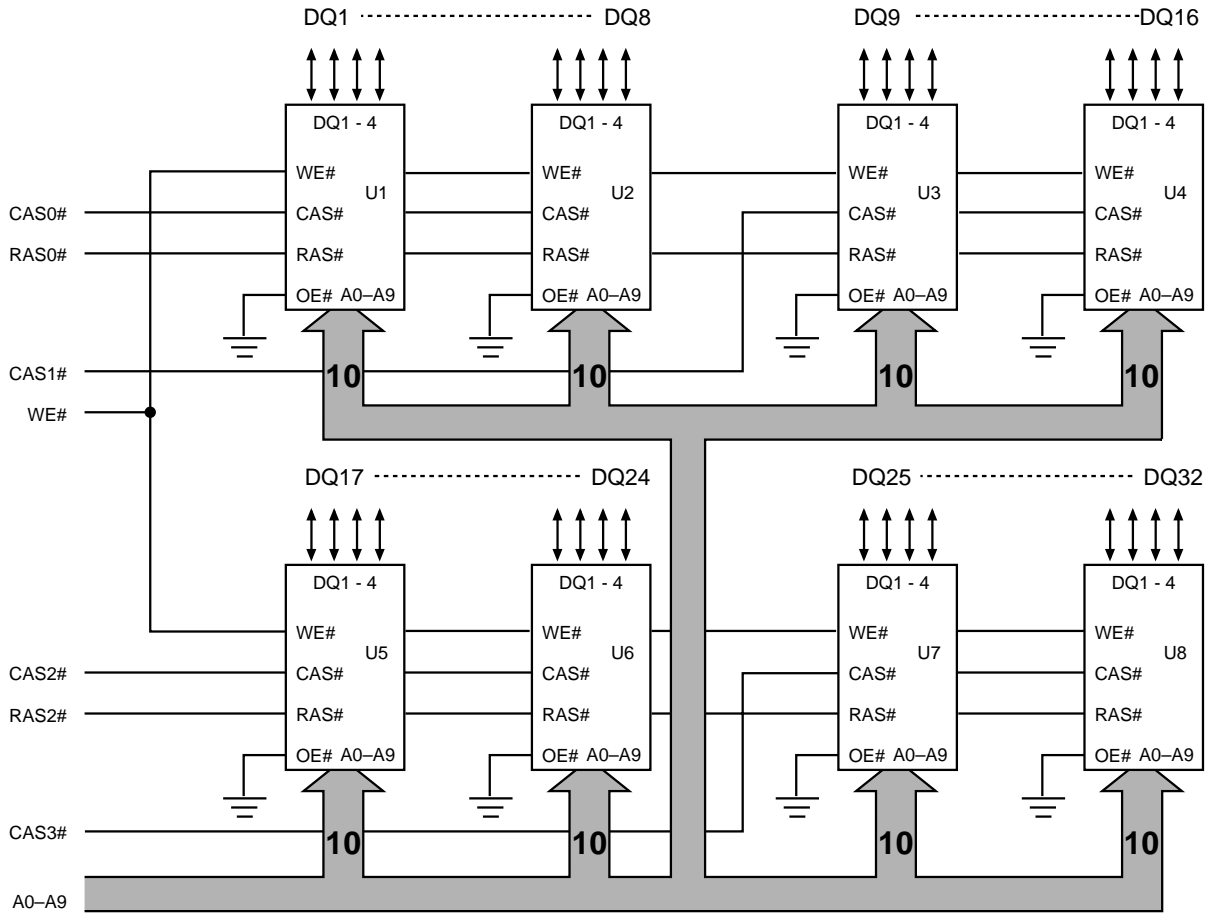
REFRESH

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.

**FUNCTIONAL BLOCK DIAGRAM
MT8D132(X) (4MB)**



VCC → U1-U8
VSS → U1-U8

FAST PAGE MODE
U1-U8 = MT4C4001JDJ

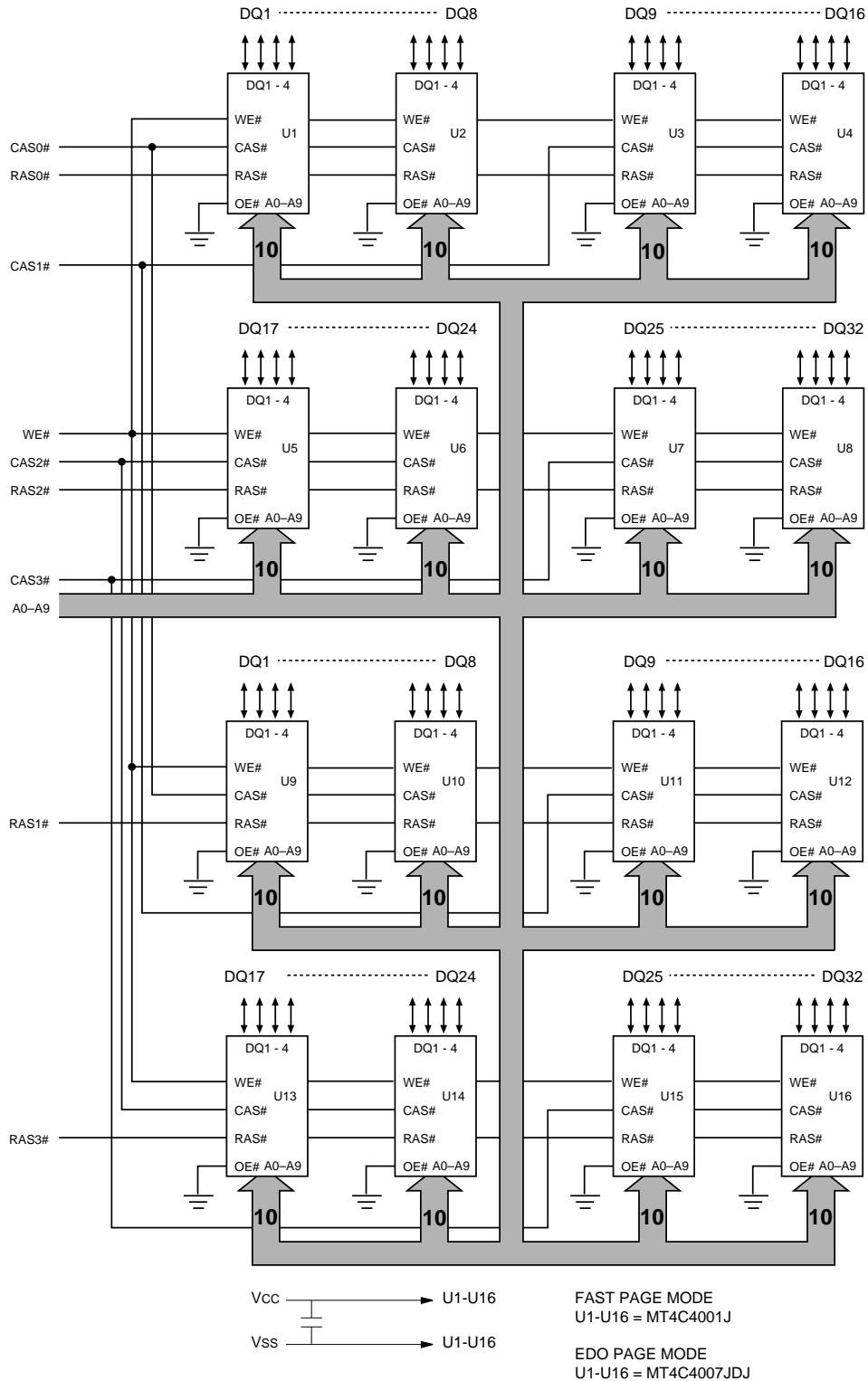
EDO PAGE MODE
U1-U8 = MT4C4007JDJ

OBSOLETE



1, 2 MEG x 32
DRAM SIMMs

FUNCTIONAL BLOCK DIAGRAM MT16D232(X) (8MB)



TRUTH TABLE

FUNCTION	RAS#	CAS#	WE#	ADDRESSES		DATA-IN/OUT	
				t _R	t _C	DQ1-DQ32	
Standby	H	H→X	X	X	X	High-Z	
READ	L	L	H	ROW	COL	Data-Out	
EARLY WRITE	L	L	L	ROW	COL	Data-In	
EDO/FAST-PAGE-MODE READ	1st Cycle	L	H→L	H	ROW	COL	Data-Out
	2nd Cycle	L	H→L	H	n/a	COL	Data-Out
	Any Cycle (X version)	L	L→H	H	n/a	n/a	Data-Out
EDO/FAST-PAGE-MODE EARLY WRITE	1st Cycle	L	H→L	L	ROW	COL	Data-In
	2nd Cycle	L	H→L	L	n/a	COL	Data-In
RAS#-ONLY REFRESH	L	H	X	ROW	n/a	High-Z	
HIDDEN REFRESH	READ	L→H→L	L	H	ROW	COL	Data-Out
	WRITE	L→H→L	L	L	ROW	COL	Data-In
CBR REFRESH	H→L	L	H	X	X	High-Z	

**JEDEC-DEFINED
PRESENCE-DETECT – MT8D132(X) (4MB)**

SYMBOL	PIN	-6
PRD1	67	V _{ss}
PRD2	68	V _{ss}
PRD3	69	NC
PRD4	70	NC

**JEDEC-DEFINED
PRESENCE-DETECT – MT16D232(X) (8MB)**

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

ABSOLUTE MAXIMUM RATINGS*

Voltage on V _{CC} 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	8W
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_{CC} = +5V ±10%)

PARAMETER/CONDITION	SYMBOL	MIN	MAX	UNITS	NOTES	
Supply Voltage	V _{CC}	4.5	5.5	V		
Input High (Logic 1) Voltage, all inputs	V _{IH}	2.4	V _{CC} +1	V		
Input Low (Logic 0) Voltage, all inputs	V _{IL}	-1.0	0.8	V		
INPUT LEAKAGE CURRENT Any input 0V ≤ V _{IN} ≤ V _{CC} +1V (All other pins not under test = 0V)	CAS0#-CAS3#	I _{I1}	-8	8	μA	23
	A0-A9, WE#	I _{I2}	-32	32	μA	23
	RAS0#-RAS3#	I _{I3}	-8	8	μA	
OUTPUT LEAKAGE CURRENT (DQ is disabled; 0V ≤ V _{OUT} ≤ 5.5V)	DQ1-DQ32	I _{OZ}	-20	20	μA	23
OUTPUT LEVELS High Voltage (I _{OUT} = -5mA) Low Voltage (I _{OUT} = 4.2mA)	V _{OH}	2.4		V		
	V _{OL}		0.4	V		

PARAMETER/CONDITION	SYMBOL	SIZE	MAX	UNITS	NOTES
			-6		
STANDBY CURRENT: (TTL) (RAS# = CAS# = V _{IH})	I _{CC1}	4MB 8MB	16 32	mA	
STANDBY CURRENT: (CMOS) (RAS# = CAS# = other inputs = V _{CC} -0.2V)	I _{CC2}	4MB 8MB	8 16	mA	
OPERATING CURRENT: Random READ/WRITE Average power supply current (RAS#, CAS#, address cycling: t _{RC} = t _{RC} [MIN])	I _{CC3}	4MB 8MB	880 896	mA	2, 22
OPERATING CURRENT: FAST PAGE MODE Average power supply current (RAS# = V _{IL} , CAS#, address cycling: t _{PC} = t _{PC} [MIN])	I _{CC4}	4MB 8MB	640 656	mA	2, 22
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 8MB	640 656	mA	2
REFRESH CURRENT: RAS#-ONLY Average power supply current (RAS# cycling, CAS# = V _{IH} : t _{RC} = t _{RC} [MIN])	I _{CC6}	4MB 8MB	880 896	mA	2, 22
REFRESH CURRENT: CBR Average power supply current (RAS#, CAS#, address cycling: t _{RC} = t _{RC} [MIN])	I _{CC7}	4MB 8MB	880 896	mA	2, 17

CAPACITANCE

PARAMETER	SYMBOL	MAX		UNITS	NOTES
		4MB	8MB		
Input Capacitance: A0-A9	C _{I1}	48	95	pF	15
Input Capacitance: WE#	C _{I2}	64	127	pF	15
Input Capacitance: RAS0#-RAS3#	C _{I4}	32	32	pF	15
Input Capacitance: CAS0#-CAS3#	C _{I5}	16	32	pF	15
Input/Output Capacitance: DQ1-DQ32	C _{I0}	10	18	pF	15

FAST PAGE MODE AC ELECTRICAL CHARACTERISTICS

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

AC CHARACTERISTICS - FAST PAGE MODE OPTION		-6		UNITS	NOTES
PARAMETER	SYMBOL	MIN	MAX		
Access time from column address	t ¹ AA		30	ns	
Column-address hold time (referenced to RAS#)	t ¹ AR	45		ns	
Column-address setup time	t ¹ ASC	0		ns	
Row-address setup time	t ¹ ASR	0		ns	
Access time from CAS#	t ¹ CAC		15	ns	
Column-address hold time	t ¹ CAH	10		ns	
CAS# pulse width	t ¹ CAS	15	10,000	ns	
CAS# hold time (CBR REFRESH)	t ¹ CHR	10		ns	17
CAS# to output in Low-Z	t ¹ CLZ	0		ns	
CAS# precharge time	t ¹ CP	10		ns	16
Access time from CAS# precharge	t ¹ CPA		35	ns	
CAS# to RAS# precharge time	t ¹ CRP	10		ns	
CAS# hold time	t ¹ CSH	60		ns	
CAS# setup time (CBR REFRESH)	t ¹ CSR	10		ns	17
Write command to CAS# lead time	t ¹ CWL	15		ns	
Data-in hold time	t ¹ DH	10		ns	13
Data-in setup time	t ¹ DS	0		ns	13
Output buffer turn-off delay	t ¹ OFF	3	15	ns	10, 21, 24
FAST-PAGE-MODE READ or WRITE cycle time	t ¹ PC	35		ns	
Access time from RAS#	t ¹ RAC		60	ns	
RAS# to column-address delay time	t ¹ RAD	15		ns	20
Row-address hold time	t ¹ RAH	10		ns	
RAS# pulse width	t ¹ RAS	60	10,000	ns	
RAS# pulse width (FAST PAGE MODE)	t ¹ RASP	60	100,000	ns	
Random READ or WRITE cycle time	t ¹ RC	110		ns	
RAS# to CAS# delay time	t ¹ RCD	20		ns	11
Read command hold time (referenced to CAS#)	t ¹ RCH	0		ns	12
Read command setup time	t ¹ RCS	0		ns	
Refresh period (1,024 cycles)	t ¹ REF		16	ms	
RAS# precharge time	t ¹ RP	40		ns	
RAS# to CAS# precharge time	t ¹ RPC	0		ns	

OBSOLETE



1, 2 MEG x 32
DRAM SIMMs

FAST PAGE MODE
AC ELECTRICAL CHARACTERISTICS

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

AC CHARACTERISTICS - FAST PAGE MODE OPTION		-6			
PARAMETER	SYMBOL	MIN	MAX	UNITS	NOTES
Read command hold time	t_{RRH}	0		ns	12
RAS# hold time	t_{RSH}	15		ns	
Write command to RAS# lead time	t_{RWL}	15		ns	
Transition time (rise or fall)	t_T	3	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

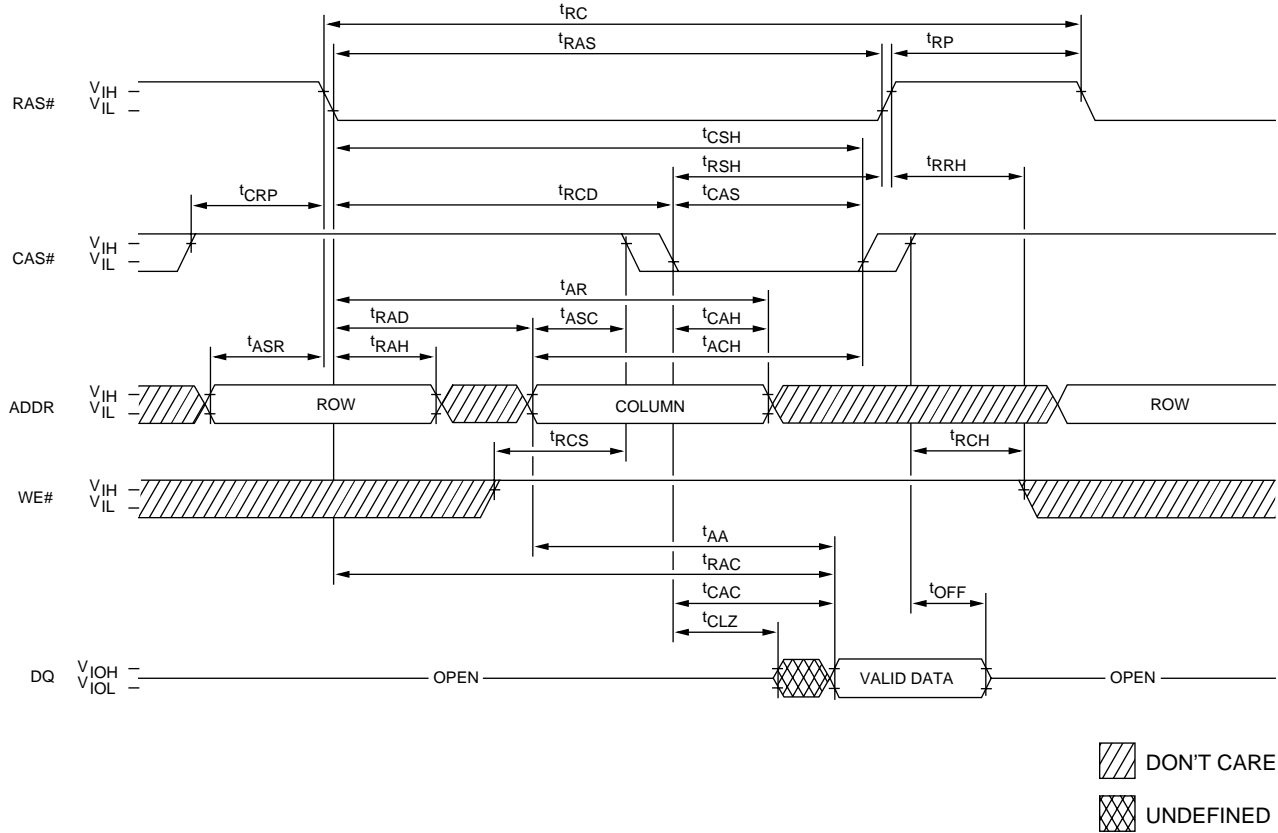
(Notes: 3, 4, 5, 6, 7, 8, 9, 14) ($V_{CC} = +5V \pm 10\%$)

AC CHARACTERISTICS - EDO PAGE MODE OPTION		-6			
PARAMETER	SYM	MIN	MAX	UNITS	NOTES
Access time from column address	t_{AA}		30	ns	
Column-address setup to CAS# precharge during WRITE	t_{ACH}	15		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}		17	ns	
Column-address hold time	t_{CAH}	10		ns	
CAS# pulse width	t_{CAS}	13	10,000	ns	
CAS# hold time (CBR REFRESH)	t_{CHR}	10		ns	17
CAS# to output in Low-Z	t_{CLZ}	3		ns	21
Data output hold after CAS# LOW	t_{COH}	5		ns	
CAS# precharge time	t_{CP}	10		ns	16
Access time from CAS# precharge	t_{CPA}		35	ns	
CAS# to RAS# precharge time	t_{CRP}	10		ns	
CAS# hold time	t_{CSH}	50		ns	
CAS# setup time (CBR REFRESH)	t_{CSR}	10		ns	17
Write command to CAS# lead time	t_{CWL}	15		ns	
Data-in hold time	t_{DH}	9		ns	13
Data-in setup time	t_{DS}	0		ns	13
Output buffer turn-off delay	t_{OFF}	3	15	ns	10, 21, 24
FAST-PAGE-MODE READ or WRITE cycle time	t_{PC}	26		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	100,000	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}	5		ns	
Read command hold time	t_{RRH}	0		ns	12
RAS# hold time	t_{RSH}	15		ns	
Write command to RAS# lead time	t_{RWL}	15		ns	
Transition time (rise or fall)	t_T	1.5	50	ns	5, 14
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	
Output disable delay from WE# (CAS# HIGH)	t_{WHZ}	3	15	ns	
Write command pulse width	t_{WP}	10		ns	
WE# pulse width for output disable when CAS# HIGH	t_{WPZ}	10		ns	
WE# hold time (CBR REFRESH)	t_{WRH}	10		ns	
WE# setup time (CBR REFRESH)	t_{WRP}	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 $100\mu s$ 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 $t_T = 5ns$ for FAST PAGE MODE and $t_T = 1.5ns$ for EDO PAGE MODE.
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 ($0^\circ C \leq T_A \leq 70^\circ C$) is ensured.
7. Measured with a load equivalent to two TTL gates and $100pF$.
8. If CAS# and RAS# = 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, $V_{CC} = 4.5V$, 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-U8/U16.
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 FAST PAGE MODE 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# signal to transition HIGH.
25. Applies to both EDO and FAST PAGE MODEs.

READ CYCLE ²⁵

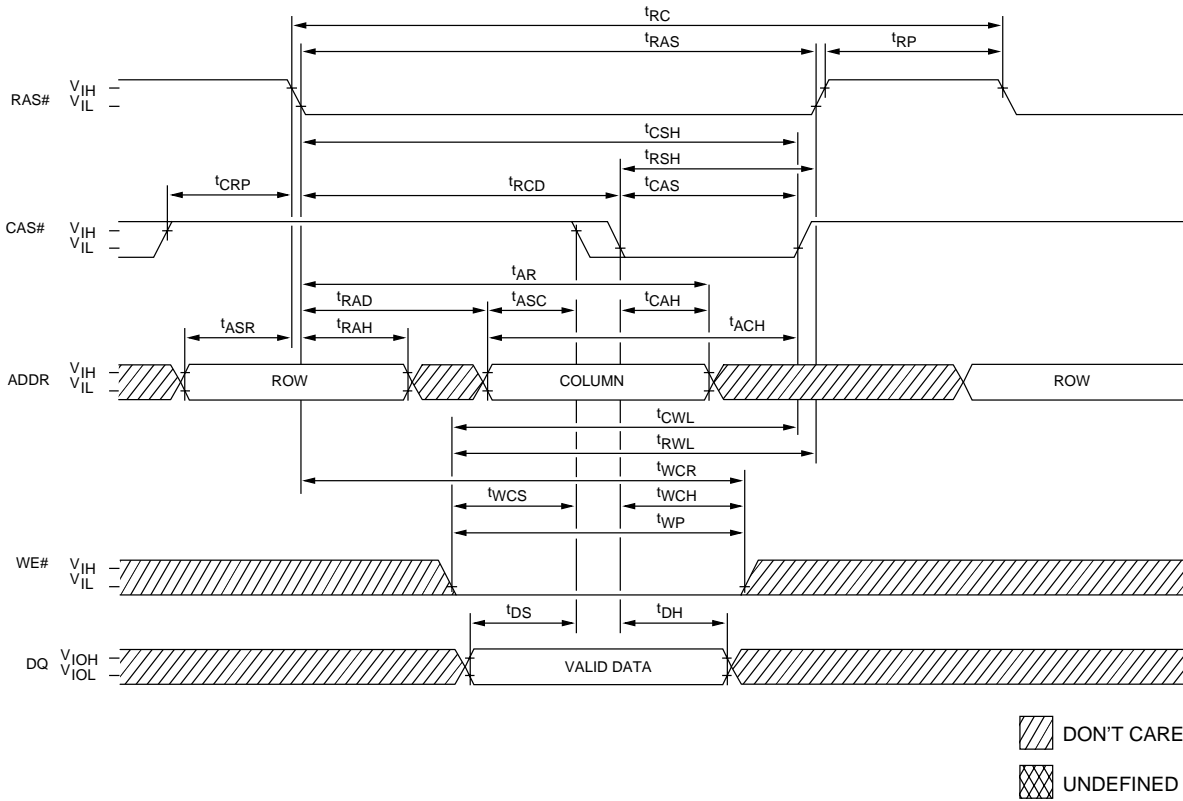


**FAST PAGE MODE AND EDO PAGE MODE
TIMING PARAMETERS**

SYMBOL	-6		UNITS
	MIN	MAX	
tAA		30	ns
tACH	15		ns
tAR	45		ns
tASC	0		ns
tASR	0		ns
tCAC (FPM)		15	ns
tCAC (EDO)		17	ns
tCAH	10		ns
tCAS (FPM)	15	10,000	ns
tCAS (EDO)	13	10,000	ns
tCLZ (FPM)	0		ns
tCLZ (EDO)	3		ns
tCRP	10		ns
tCSH (FPM)	60		ns

SYMBOL	-6		UNITS
	MIN	MAX	
tCSH (EDO)	50		ns
tOFF	3	15	ns
tRAC		60	ns
tRAD	15		ns
tRAH	10		ns
tRAS	60	10,000	ns
tRC	110		ns
tRCD	20		ns
tRCH	0		ns
tRCS	0		ns
tRP	40		ns
tRRH	0		ns
tRSH	15		ns

EARLY WRITE CYCLE ²⁵



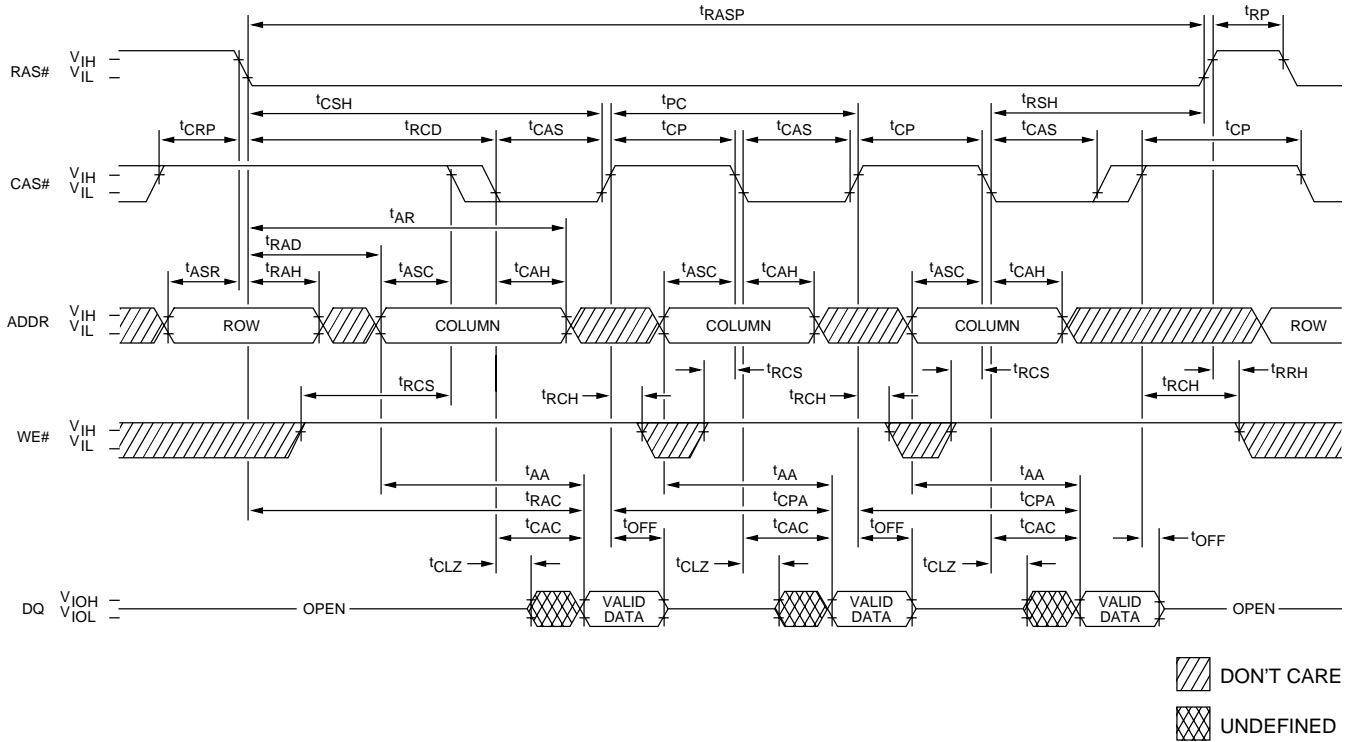
DON'T CARE
 UNDEFINED

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

SYMBOL	-6		UNITS
	MIN	MAX	
t ['] ACH (EDO)	15		ns
t ['] AR	45		ns
t ['] ASC	0		ns
t ['] ASR	0		ns
t ['] CAH	10		ns
t ['] CAS (FPM)	15	10,000	ns
t ['] CAS (EDO)	13	10,000	ns
t ['] CRP	10		ns
t ['] CSH (FPM)	60		ns
t ['] CSH (EDO)	50		ns
t ['] CWL	15		ns
t ['] DH (FPM)	10		ns
t ['] DH (EDO)	9		ns

SYMBOL	-6		UNITS
	MIN	MAX	
t ['] DS	0		ns
t ['] RAD	15		ns
t ['] RAH	10		ns
t ['] RAS	60	10,000	ns
t ['] RC	110		ns
t ['] RCD	20		ns
t ['] RP	40		ns
t ['] RSH	15		ns
t ['] RWL	15		ns
t ['] WCH	10		ns
t ['] WCR	45		ns
t ['] WCS	0		ns
t ['] WP	10		ns

FAST-PAGE-MODE READ CYCLE

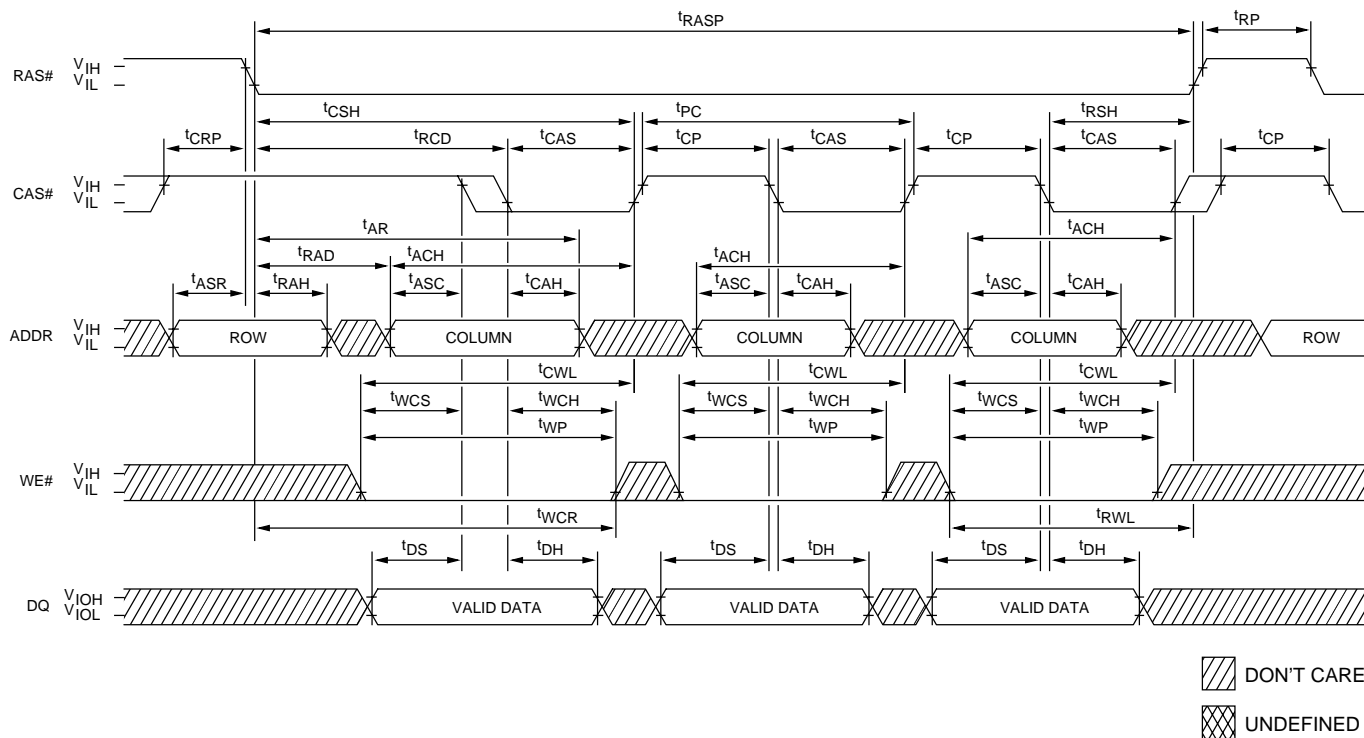


**FAST PAGE MODE
TIMING PARAMETERS**

SYMBOL	-6		UNITS
	MIN	MAX	
tAA		30	ns
tAR	45		ns
tASC	0		ns
tASR	0		ns
tCAC		15	ns
tCAH	10		ns
tCAS	15	10,000	ns
tCLZ	0		ns
tCP	10		ns
tCPA		35	ns
tCRP	10		ns
tCSH	60		ns

SYMBOL	-6		UNITS
	MIN	MAX	
tOFF	3	15	ns
tPC	35		ns
tRAC		60	ns
tRAD	15		ns
tRAH	10		ns
tRASP	60	100,000	ns
tRCD	20		ns
tRCH	0		ns
tRCS	0		ns
tRP	40		ns
tRRH	0		ns
tRSH	15		ns

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

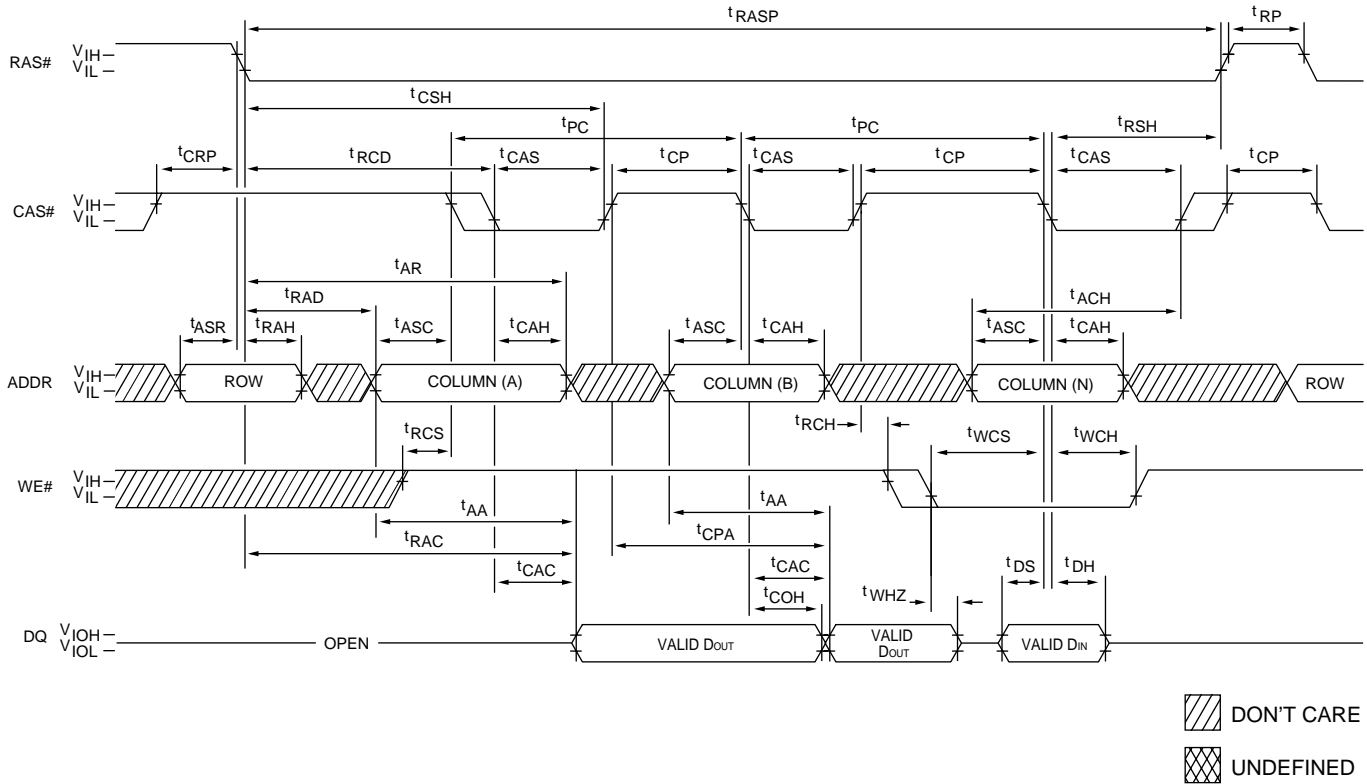


**FAST PAGE MODE AND EDO PAGE MODE
TIMING PARAMETERS**

SYMBOL	-6		UNITS
	MIN	MAX	
tAR	45		ns
tASC	0		ns
tASR	0		ns
tCAH	10		ns
tCAS (FPM)	15	10,000	ns
tCAS (EDO)	13	10,000	ns
tCP	10		ns
tCRP	10		ns
tCSH (FPM)	60		ns
tCSH (EDO)	50		ns
tCWL	15		ns
tDH (FPM)	10		ns
tDH (EDO)	9		ns
tDS	0		ns

SYMBOL	-6		UNITS
	MIN	MAX	
tPC (FPM)	35		ns
tPC (EDO)	26		ns
tRAD	15		ns
tRAH	10		ns
tRASP	60	100,000	ns
tRCD	20		ns
tRP	40		ns
tRSH	15		ns
tRWL	15		ns
tWCH	10		ns
tWCR	45		ns
tWCS	0		ns
tWP	10		ns

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

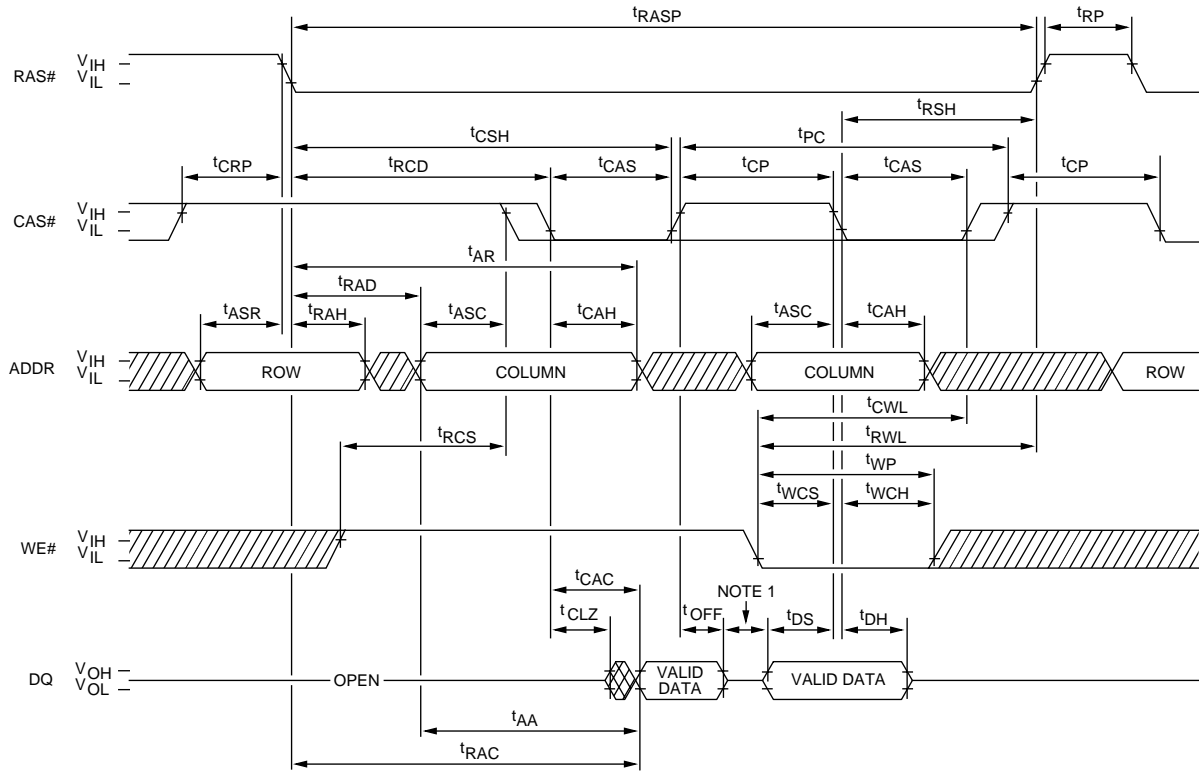


**EDO PAGE MODE
TIMING PARAMETERS**

SYMBOL	-6		UNITS
	MIN	MAX	
tAA		30	ns
tACH	15		ns
tAR	45		ns
tASC	0		ns
tASR	0		ns
tCAC		17	ns
tCAH	10		ns
tCAS	13	10,000	ns
tCOH	5		ns
tCP	10		ns
tCPA		35	ns
tCRP	10		ns
tCSH	50		ns
tDH	9		ns

SYMBOL	-6		UNITS
	MIN	MAX	
tDS	0		ns
tPC	26		ns
tRAC		60	ns
tRAD	15		ns
tRAH	10		ns
tRASP	60	100,000	ns
tRCD	20		ns
tRCH	0		ns
tRCS	0		ns
tRP	40		ns
tRSH	15		ns
tWCH	10		ns
tWCS	0		ns
tWHZ	3	15	ns

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



DON'T CARE
 UNDEFINED

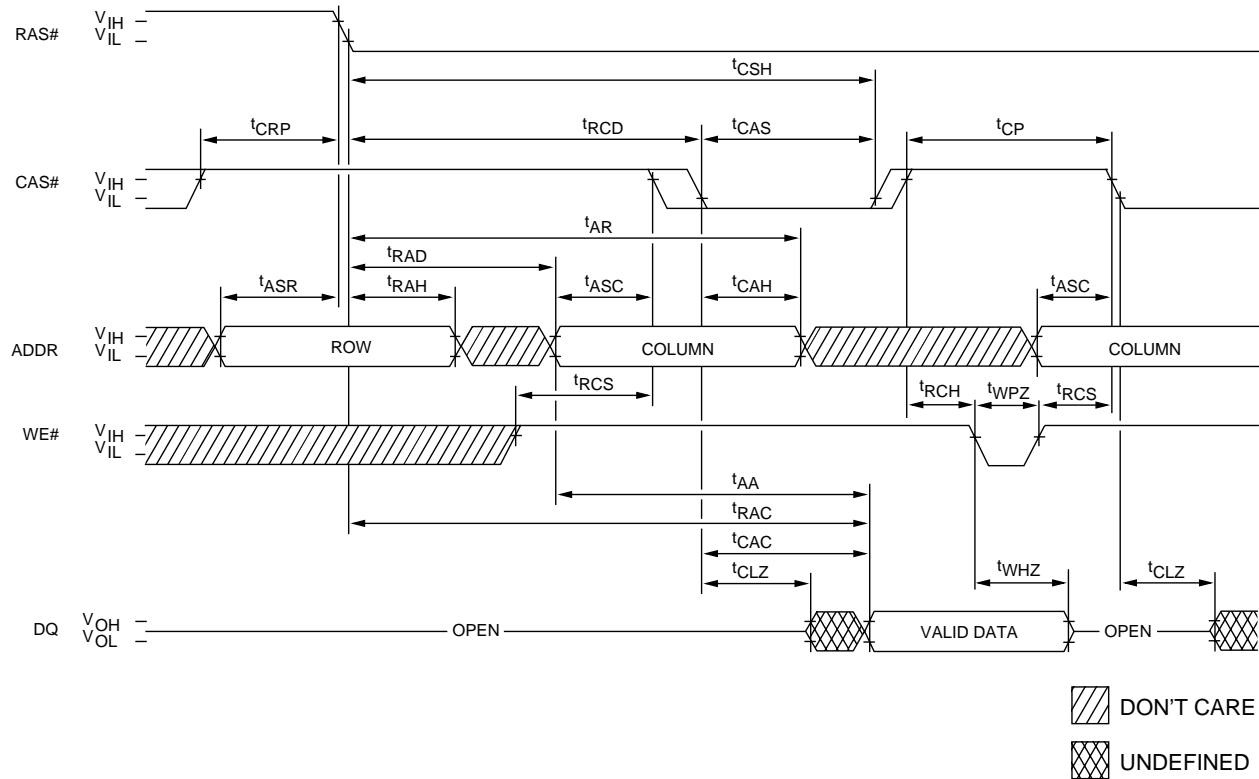
**FAST PAGE MODE
TIMING PARAMETERS**

SYMBOL	-6		UNITS
	MIN	MAX	
tAA		30	ns
tAR	45		ns
tASC	0		ns
tASR	0		ns
tCAC		15	ns
tCAH	10		ns
tCAS	15	10,000	ns
tCLZ	0		ns
tCP	10		ns
tCRP	10		ns
tCSH	60		ns
tCWL	15		ns
tDH	10		ns
tDS	0		ns

SYMBOL	-6		UNITS
	MIN	MAX	
tOFF	3	15	ns
tPC	35		ns
tRAC		60	ns
tRAD	15		ns
tRAH	10		ns
tRASP	60	100,000	ns
tRCD	20		ns
tRCS	0		ns
tRP	40		ns
tRSH	15		ns
tRWL	15		ns
tWCH	10		ns
tWCS	0		ns
tWP	10		ns

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

EDO READ CYCLE
(with WE#-controlled disable)

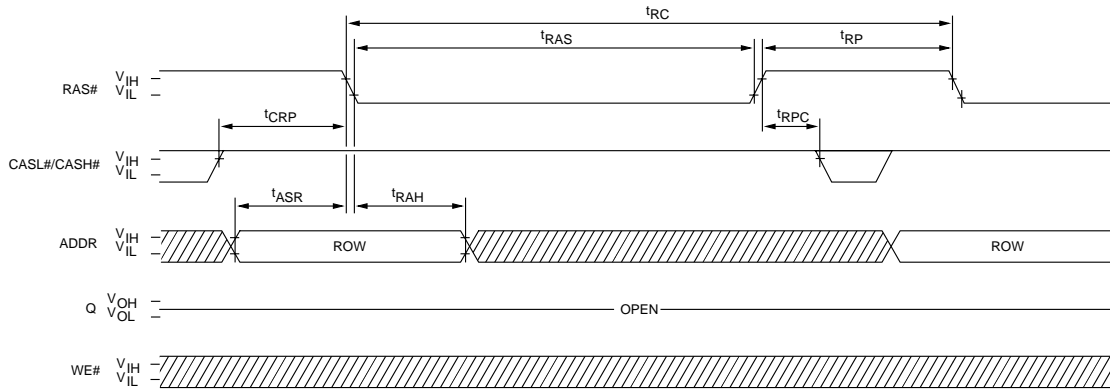


EDO PAGE MODE
TIMING PARAMETERS

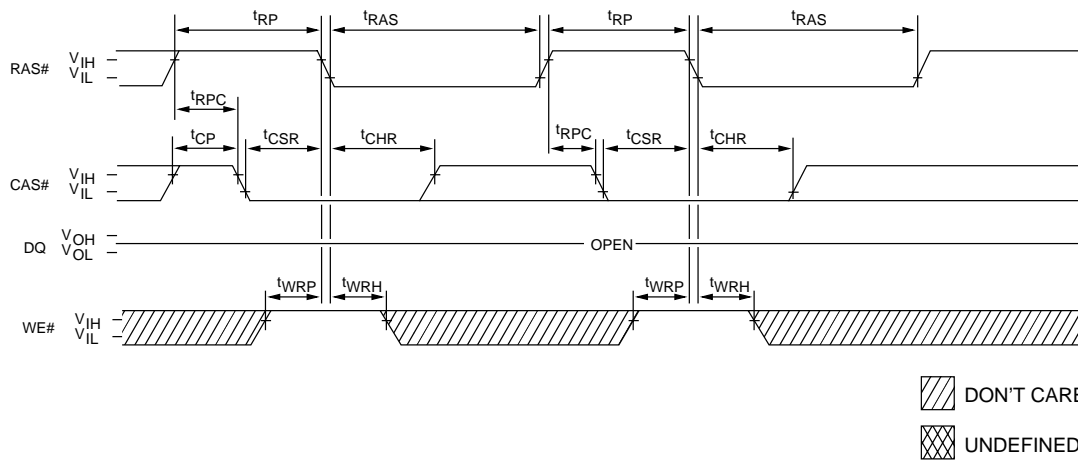
SYMBOL	-6		UNITS
	MIN	MAX	
t_{AA}		30	ns
t_{AR}	45		ns
t_{ASC}	0		ns
t_{ASR}	0		ns
t_{CAC}		17	ns
t_{CAH}	10		ns
t_{CAS}	13	10,000	ns
t_{CLZ}	3		ns
t_{CP}	10		ns
t_{CRP}	10		ns

SYMBOL	-6		UNITS
	MIN	MAX	
t_{CSH}	50		ns
t_{RAC}		60	ns
t_{RAD}	15		ns
t_{RAH}	10		ns
t_{RCD}	20		ns
t_{RCH}	0		ns
t_{RCS}	0		ns
t_{WHZ}	3	15	ns
t_{WPZ}	10		ns

RAS#-ONLY REFRESH CYCLE ²⁵



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

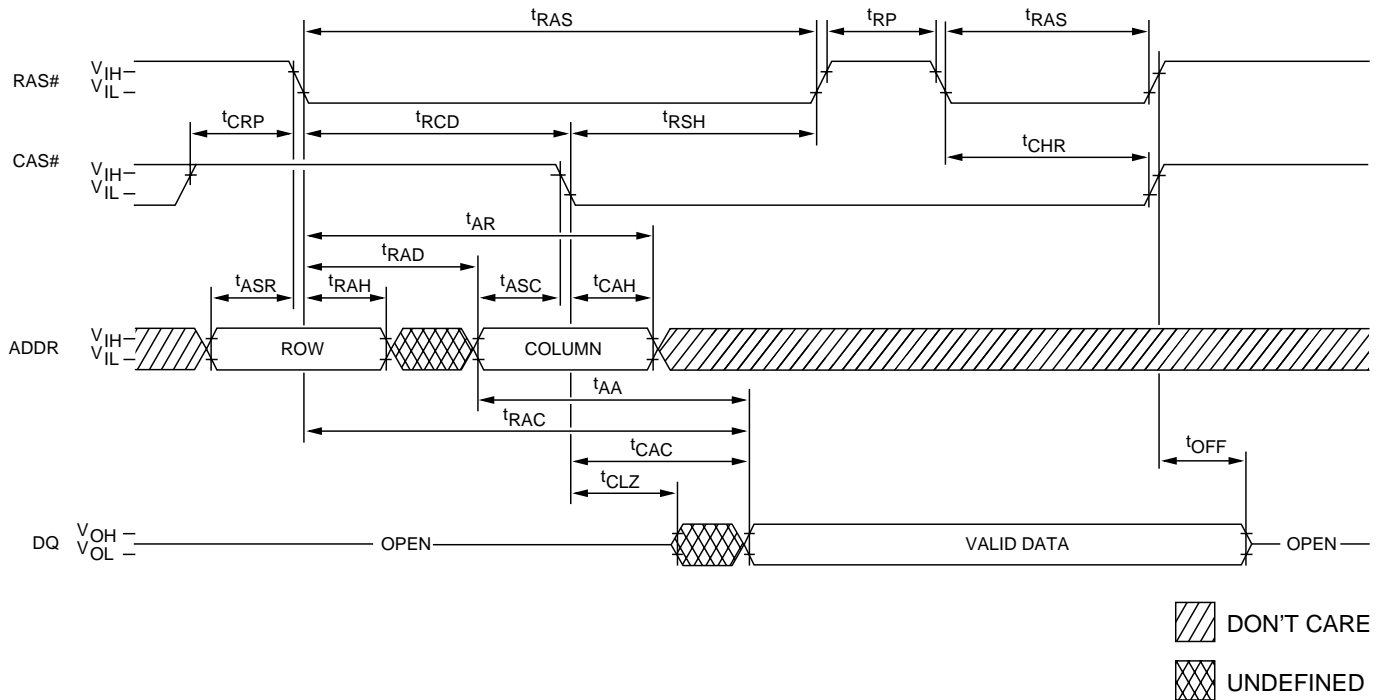


**FAST PAGE MODE AND EDO PAGE MODE
TIMING PARAMETERS**

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

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

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



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

SYMBOL	-6		UNITS
	MIN	MAX	
tAA		30	ns
tAR	45		ns
tASC	0		ns
tASR	0		ns
tCAC (FPM)		15	ns
tCAC (EDO)		17	ns
tCAH	10		ns
tCHR	10		ns
tCLZ	3		ns

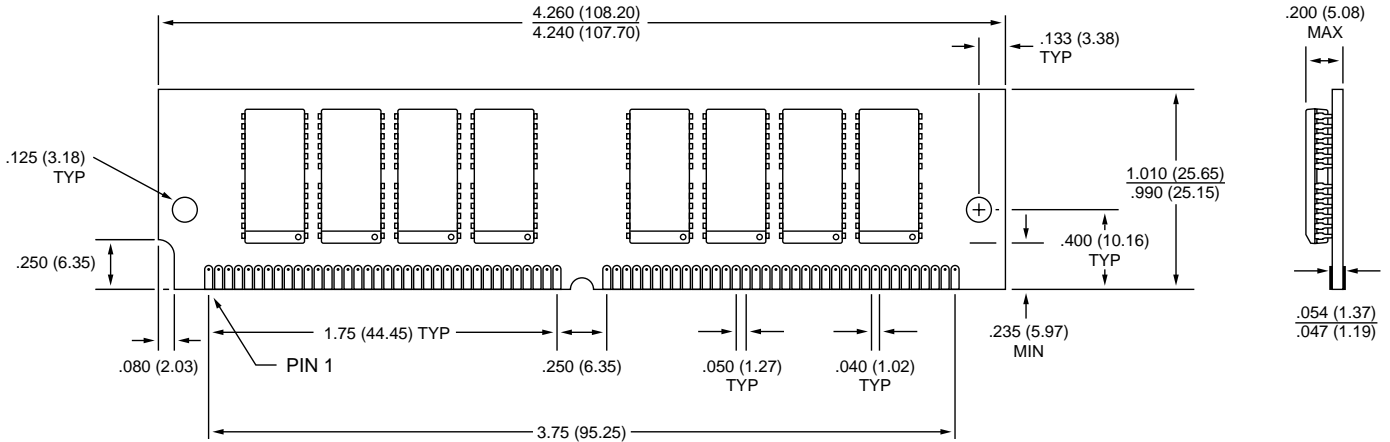
SYMBOL	-6		UNITS
	MIN	MAX	
tCRP	10		ns
tOFF	3	15	ns
tRAC		60	ns
tRAD	15		ns
tRAH	10		ns
tRAS	60	10,000	ns
tRCD	20		ns
tRP	40		ns
tRSH	15		ns

OBSOLETE

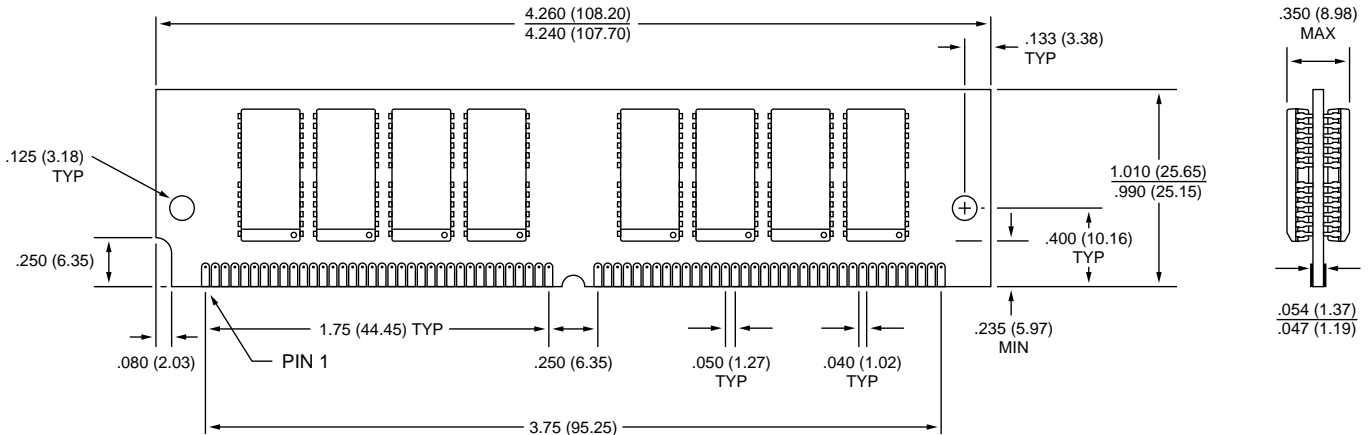


1, 2 MEG x 32
DRAM SIMMs

72-Pin SIMM (4MB)



72-Pin SIMM (8MB)



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



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