Rev. 1.3 **256K WORD X 16 BIT EDO DRAM**

FEATURES

- Parts Identification-
  - UT51C164 (5V version)
  - UT51L164 (3.3V version)
- Extended Data Out operation
- RAS# access time: 35, 40, 50, 60
- 2 CAS# Byte/Word Read/Write operation
- CAS# - before – RAS# refresh capability
- RAS – only and Hidden refresh capability
- Early write or output enable controlled write
- Package : 40 pin 400mil SOJ packages
  40/44 pin 400mil TSOP- Ⅱ packages
- Single +5V±10% power supply – UT51C164
- Single +3.3V±10% power supply – UT51L164
- TTL compatible inputs and outputs
- 512 refresh cycles /8ms

Speed	-35	-40	-50	-60
t_{RAC}	35ns	40ns	50ns	60ns
t_{CAA}	18ns	20ns	24ns	30ns
t_{PC}	14ns	15ns	19ns	27ns
t_{CAC}	11ns	12ns	14ns	15ns
t_{RC}	70ns	75ns	90ns	110ns

GENERAL DESCRIPTION

The UT51C164/UT51L164 is high speed 5 Volt / 3.3 Volt EDO DRAMs organized as 256K bit X 16 I/O and fabricated with the CMOS process. The UT51C164/UT51L164 offers a combination of unique features including: EDO Page Mode operation for higher bandwidth with Page Mode cycle time as short as 14ns. All inputs are TTL compatible. Input and output capacitance is significantly lowered to increase performance and minimize loading. These features make the UT51C164/UT51L164 suited for wide variety of high performance computer systems and peripheral applications.

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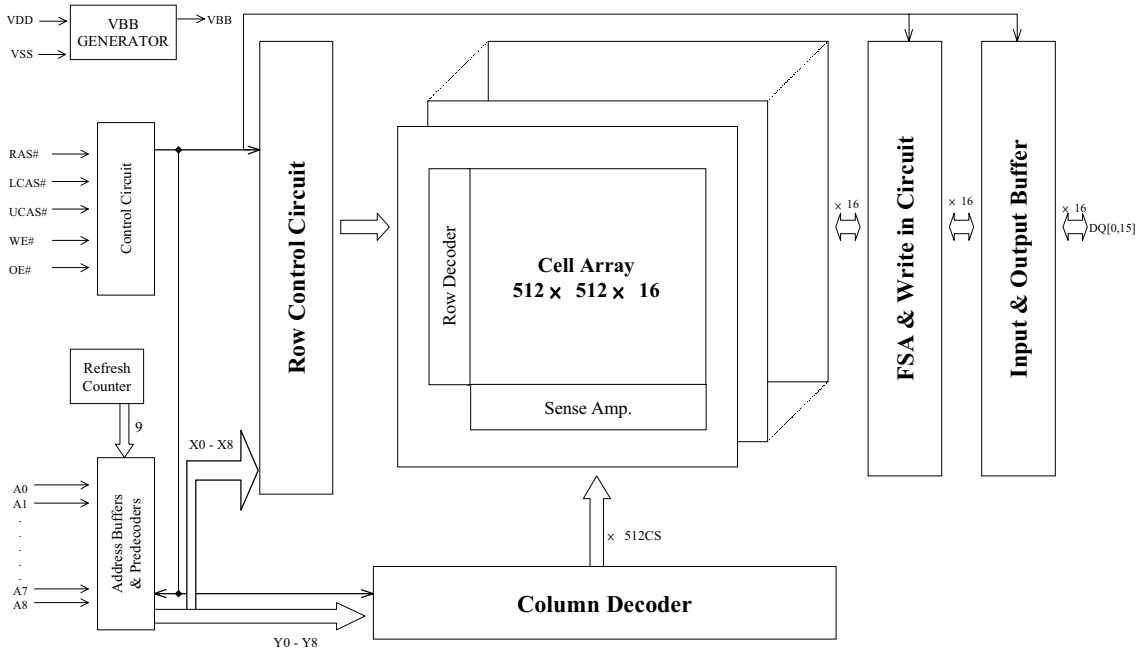
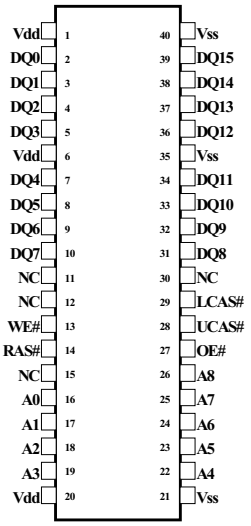
Utron Block Diagram

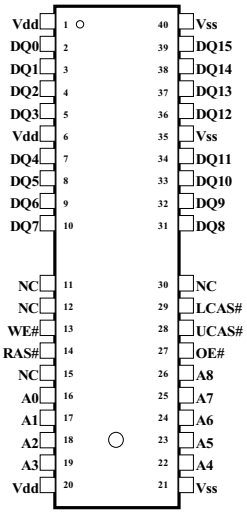


PIN ARRANGEMENT

UT51C164/UT51L164
40-pin SOJ package



UT51C164 / UT51L164
40/44-pin TSOP-Ⅱ package



PIN DESCRIPTION

A0-A8	Address Inputs
RAS#	Row Address Strobe
UCAS#	Column Address Strobe/Upper Byte Control
LCAS#	Column Address Strobe/Lower Byte Control
WE#	Write enable
OE#	Output enable
DQ0-DQ15	Data Input, Data Output
V_{DD}	+5V / +3.3V Supply
Vss	0V Supply
NC	No Connect

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit	Notes
Voltage on any pin relative to Vss	V_T	-1.0 to +7V	V	
Supply voltage relative to V_{SS}	Vdd	-1.0 to +7V -1.0 to +4.5V	V	
Short circuit output current	Iout	50	mA	
Power dissipation	P_T	1.0	W	
Operating temperature	Topr	0 to + 70	ºC	
Storage temperature	Tstg	-55 to +125	ºC	

Notes: Permanent device damage may occur if absolute maximum ratings are exceed.

Recommended DC Operating Conditions (Ta = 0 to +70ºC)

Parameter	Symbol	3.3V			5.0V			Notes
		Min	Max	Unit	Min	Max	Unit	
Supply voltage	V_{DD}	3.0	3.6	V	4.5	5.5	V	1
	Vss	0	0	V	0	0	V	-
Input high voltage	V_{IH}	2.4	V_{DD} +1V	V	2.4	V_{DD} +1V	V	1,2
Input low voltage	V_{IL}	-0.3	0.8	V	-0.3	0.8	V	1,3

Notes: 1. All Voltage referred to Vss

Capacitance(Ta = 25ºC, 5V device：5V±10% ；3.3V device：3.3V ±0.3V , f=1MHz)

	Symbol	Typ	Max	Unit
Input capacitance(A0-A8)	Cin1	3	4	pF
Input Capacitance (RAS#, UCAS# , LCAS# ,WE# , OE#)	Cin2	4	5	pF
Output capacitance(DQ0-DQ15)	Cdq	5	7	pF

DC Characteristics (Ta = 0 to 70ºC, 5V device ：V_{DD} = 5.0 V ± 0.5 V, Vss = 0 V)
DC Characteristics (Ta = 0 to 70ºC, 3.3V device ：V_{DD} = 3.3 V ± 0.3 V, Vss = 0 V)

Symbol	Parameter	Speed (t_{RAC})	UT51C164		UT51L164		unit	Test condition
			Min	Max	Min	Max		
I_{DD1}	Operating current, Vdd supply	-35		190		150	mA	t_{RC} = t_{RC} (min.)
		-40		180		140		
		-50		170		130		
		-60		160		120		
I_{DD2}	Standby current (TTL input)			3		3	mA	RAS# = UCAS# = LCAS# = V_{IH}
I_{DD3}	RAS-only refresh current	-35		190		150	mA	t_{RC} = t_{RC} (min.)
		-40		180		140		
		-50		170		130		
		-60		160		120		
I_{DD4}	EDO page mode current	-35		220		190	mA	t_{PC} = t_{PC} (min.)
		-40		200		170		
		-50		190		160		
		-60		180		150		
I_{DD5}	CBR refresh current	-35		190		150	mA	t_{RC} = t_{RC} (min.)
		-40		180		140		
		-50		170		130		
		-60		160		120		
I_{DD6}	Standby current (CMOS input)			2		2	mA	RAS# ≧ VDD-0.2V CAS# ≧ VDD-0.2V All other inputs>= VSS
VDD	Power Supply		4.5	5.5	3	3.6	V	
I_{LI}	Input Leakage Current		-10	-10	-10	10	uA	VSS≦ Vin ≦Vdd
I_{LO}	Output Leakage Current		-10	-10	-10	10	uA	VSS≦ V_{OUT} ≦Vdd RAS# = CAS# = V_{IH}
V_{IL}	Input Low Voltage		-1	0.8	-1	0.8	V	
V_{IH}	Input High Voltage		2.4	Vdd+1	2.0	Vdd+1	V	
V_{OL}	Output Low Voltage			0.4		0.4	V	Iol =2mA
V_{OH}	Output High Voltage		2.4		2.0		V	Ioh = 2mA

Notes: I_{DD1}, I_{DD3}, I_{DD4}, I_{DD5} are dependent on output loading and cycle rates. Specified values are obtained with the output open. I_{DD} is specified as an average current. In I_{DD1}, I_{DD3}, and I_{DD5} address can be changed maximum once while RAS#=Vil. In I_{DD4}, address can be changed maximum once within one EDO page cycle time, t_{PC}.

AC Characteristics (Ta = 0 to 70°C, Vdd = 5V ± 10%, Vss = 0 V)
Test condition: V_{DD} = 5.0V±10%, Vih/Vil=3V/0V, Voh/Vol=2.0/0.8)
Test condition: V_{DD} = 3.3V±0.3V, Vih/Vil=2.4V/0.4V, Voh/Vol=2.0/0.8)

	Symbol	Parameter	35		40		50		60		unit	
			Min.	Max	Min.	Max	Min.	Max	Min.	Max		
1	t_{RAS}	RAS# Pulse Width	35	75K	40	75K	50	75K	60	75K	ns	
2	t_{RC}	Read or Write Cycle Time	70		75		90		110		ns	
3	t_{RP}	RAS# Precharge Time	25		25		30		40		ns	
4	t_{CSH}	CAS# Hold Time	35		40		50		60		ns	
5	t_{CAS}	CAS# Pulse Width	8		8		10		10		ns	
6	t_{RCD}	RAS# to CAS# Delay	13	24	17	28	19	36	20	45	ns	
7	t_{RCS}	Read Command Setup Time	0		0		0		0		ns	*1
8	t_{ASR}	Row Address Setup Time	0		0		0		0		Ns	
9	t_{RAH}	Row Address hold Time	6		7		9		10		ns	
10	t_{ASC}	Column Address Setup Time	0		0		0		0		ns	
11	t_{CAH}	Column Address Hold Time	6		7		9		10		ns	
12	t_{RSH}	RAS# to CAS# Hold Time	10		12		14		15		ns	
13	t_{CRP}	CAS# to RAS# Precharge Time	5		5		5		5		ns	
14	t_{RCH}	Read Command Hold Time Refrence CAS#	0		0		0		0		ns	*2
15	t_{RRH}	Read Command Hold Time Refrence RAS#	0		0		0		0		ns	*2
16	t_{ROH}	RAS# Hold Time Refrenced to OE#	7		8		10		10		ns	
17	t_{OAC}	Access Time from OE#		11		12		14		15	ns	*9
18	t_{CAC}	Access Time from CAS#		11		12		14		15	ns	*3,4,11
19	t_{RAC}	Access Time from RAS#		35		40		50		60	ns	*3,5,6
20	t_{CAA}	Access Time From Column Address		18		20		24		30	ns	*3,4,7
21	t_{LZ}	OE# or CAS# to Low-Z Output	0		0		0		0		ns	*13
22	t_{HZ}	OE# or CAS# to High-Z Output	0	5	0	6	0	8	0	10	ns	*13
23	t_{AR}	Column Address Hold Time from RAS#	25		30		40		50		ns	
24	t_{RAD}	RAS# to Column Address Delay Time	10	17	12	20	14	26	15	30	ns	*8
25	t_T	Transition Time	1.5	50	1.5	50	1.5	50	1.5	50	ns	*12
26	t_{CWL}	Write Command to CAS# Lead Time	8		10		10		10		ns	
27	t_{WCS}	Write Command Setup Time	0		0		0		0		ns	*9,10
28	t_{WCH}	Write Command Hold time	5		6		7		10		ns	

AC Characteristics (Ta = 0 to 70°C,5V device ：V_{DD} = 5V ± 10%, Vss = 0 V)
AC Characteristics (Ta = 0 to 70°C,3.3V device ： V_{DD} = 3V ± 0.3V, Vss = 0 V)

	Symbol	Parameter	35		40		50		60		unit	
			Min.	Max	Min.	Max	Min.	Max	Min.	Max		
29	t_{WP}	Write Pulse Width	5		6		7		10		ns	
30	t_{WCR}	Write Command Hold Time from RAS#	25		30		40		50		ns	
31	t_{RWL}	Write Command to RAS# Lead Time	11		12		14		15		ns	
32	t_{DS}	Data in Setup Time	0		0		0		0		ns	*11
33	t_{DH}	Data in Hold Time	5		6		7		10		ns	*11
34	t_{WOH}	Write to OE# Hold time	5		6		8		10		ns	*11
35	t_{OED}	OE# to Data Delay Time	5		6		8		10		ns	*11
36	t_{RWC}	Read-Modify-Write Cycle Time	105		110		130		170		Ns	
37	t_{RRW}	Read-Modify-Write Cycle Time RAS# Pulse Width	70		75		85		105		ns	
38	t_{CWD}	CAS# to WE# Delay in Read-Modify-Write Cycle	28		30		34		40		ns	*9
39	t_{RWD}	RAS# to WE# Delay in Read-Modify-Write Cycle	54		58		68		85		ns	*9
40	t_{CRW}	CAS# pulse Width in RMW	46		48		52		65		ns	
41	t_{AWD}	Column Address to WE# Delay Time	35		38		42		58		ns	*9
42	t_{PC}	EDO Page Mode Read or Write Cycle Time	14		15		19		27		ns	
43	t_{CP}	CAS# Precharge Time	4		5		7		10		ns	
44	t_{CAR}	Column Address to RAS# Setup Time	18		20		24		30		ns	
45	t_{CAP}	Access Time from Column Precharge		20		23		27		34	ns	*4
46	t_{DHR}	Data in Hold Time Refrenced to RAS#	25		30		40		50		ns	
47	t_{CSR}	CAS# Setup Time in CBR Refresh	8		10		10		10		ns	
48	t_{RPC}	RAS# to CAS# Precharge Time	0		0		0		0		ns	
49	t_{CHR}	CAS# Hold Time in CBR Refresh	8		9		12		15		ns	
50	t_{PCM}	EDO Page Mode Cycle Time in RMW	55		60		70		85		ns	
51	t_{COH}	Output Hold After CAS# Low	3		3		3		3		ns	
52	t_{OES}	OE# Low to CAS# High Setup Time	3		4		6		8		ns	
53	t_{OEH}	OE# Hold Time from WE# in RMW Cycle	5		6		8		10		ns	
54	t_{OEP}	OE# Pulse Width	8		10		14		18		ns	
55	t_{REF}	Refresh Interval (512 Cycles)		8		8		8		8	ms	*14

Notes:

1. t_{RCD} (Max.) is specified for refrence only. Operation within t_{RCD} (Max.) limits insures that t_{RAC} (Max.) and t_{CAA} (Max.) can be met. If t_{RCD} is greater than the specified t_{RCD} (Max.), the access time is controlled by t_{CAA} and $t_{CAC.}$

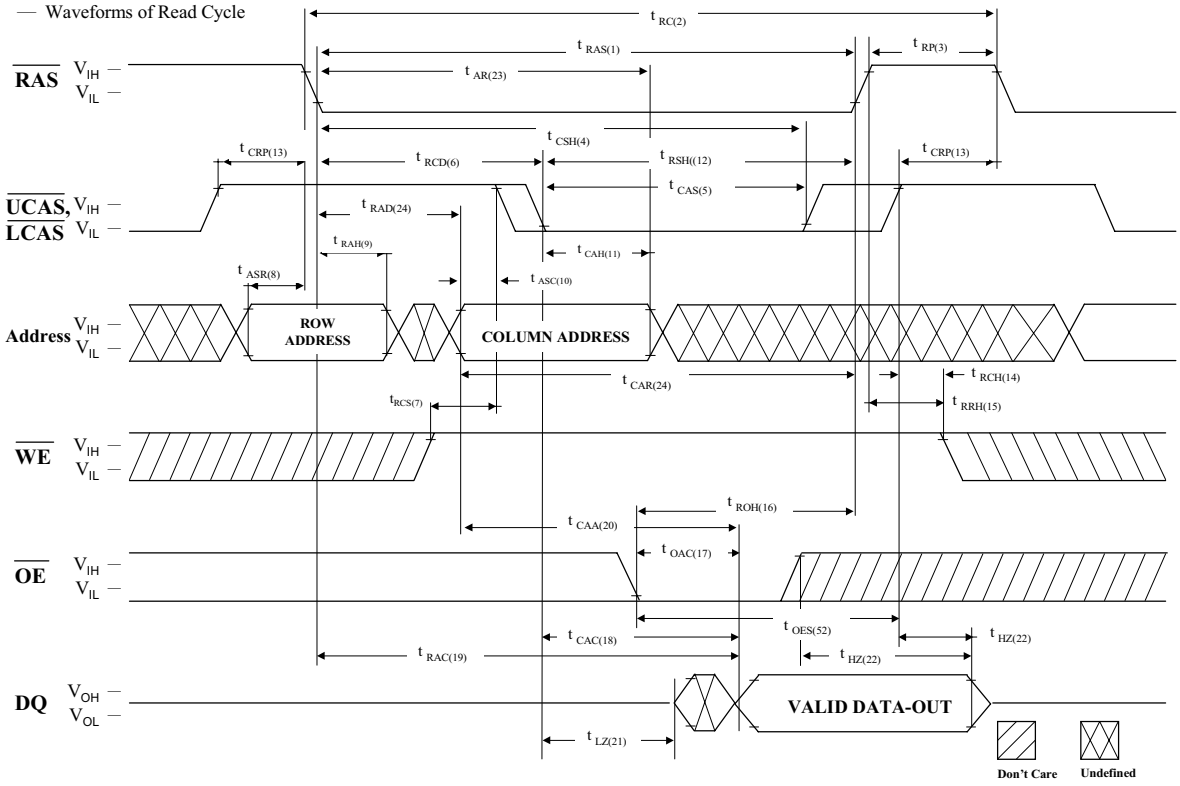
2. Either t_{RRH} or t_{RCH} must be satisified for Read Cycle to occur.
3. Measured with a load equivalent to one TTL input and 50pF.
4. Access time is determined by the longest of t_{CAA} , t_{CAC} and t_{CAP} .
5. Assumes that $t_{RAD} \leqq t_{RAD}$ (Max.). If t_{RCD} is greater than t_{RCD} (Max.), t_{RAC} will increase by the amount that t_{RCD} exceeds t_{RCD} (Max.)
6. Assumes that $t_{RCD} \leqq t_{RCD}$ (Max.). If t_{RCD} is greater than t_{RCD} (Max.), t_{RAC} will increase by the amount that t_{RAD} exceeds t_{RAD} (Max.)
7. Assumes that $t_{RAD} \geqq t_{RAD}$ (Max.).
8. Operation within the t_{RAD} (Max.) limits ensures that t_{RA} can be met. t_{RAD} (Max.) is specified as a reference point only. If t_{RAD} is greater than the specified t_{RAD} (Max.), the access time is controlled by t_{CAA} and $t_{CAC.}$
9. t_{WCS} , t_{RWD} , t_{AWD} and t_{CWD} are not restrictive operating parameters.
10. t_{WCS} (min.) must be satisfied in an Early Write Cycle.
11. t_{DS} and t_{DH} are referenced to the latter occurrence of CAS# or WE#.
12. t_T is measured between V_{IH} (min.) and V_{IL} (max.). AC-measurements assume t_T = 3Ns.
13. Assumes a tri-state test load (5pF and a 500Ohm Thevenin equivalent).
14. An initial pause of 200us is required after power-up followed by any 8 CBR or ROR cycles before device operation is achieved.

Truth Table

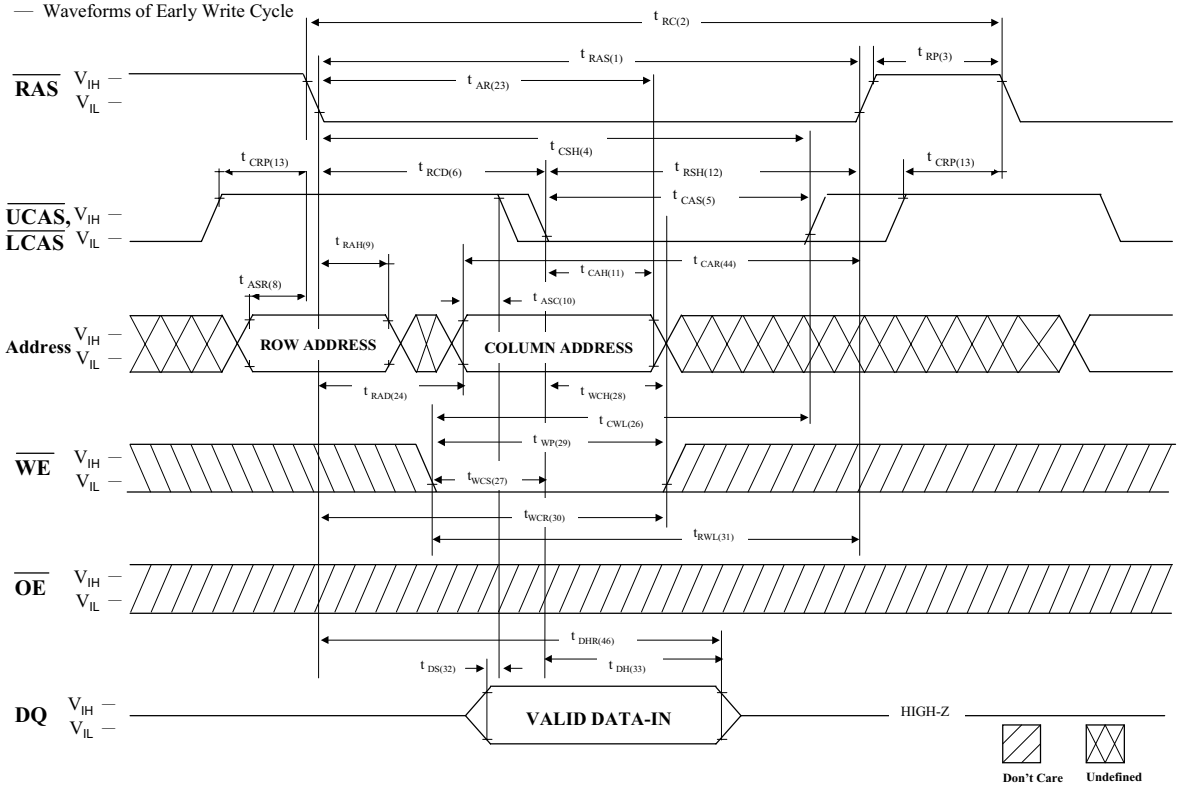
Function	RAS#	LCAS#	UCAS#	WE#	OE#	ADDRESS	DQ0-7	DQ8-15	
Standby	H	H	H	X	X	X	High-Z	High-Z	
Read:Word	L	L	L	H	L	ROW/COL	DQ-OUT		
Read: Lower Byte	L	L	H	H	L	ROW/COL	DQ-OUT	High-Z	
Read: Upper Byte	L	H	L	H	L	ROW/COL	High-Z	DQ-OUT	
Write: Word (Early-Write)	L	L	L	L	X	ROW/COL	DQ-IN		
Write: Lower Byte (Early-Write)	L	L	H	L	X	ROW/COL	DQ-IN	High-Z	
Write: Upper Byte (Early-Write)	L	H	L	L	X	ROW/COL	High-Z	DQ-IN	
Read-Write	L	L	L	H→L	L→H	ROW/COL	DQ-OUT,DQ-IN		*1,2
EDO Page-Mode Read	L	H→L	H→L	H	L	COL	DQ-OUT		*2
EDO Page-Mode Write	L	H→L	H→L	L	X	COL	DQ-IN		*2
EDO Page –Mode Read-Write	L	H→L	H→L	H→L	L→H	COL	DQ-OUT,DQ-IN		*1,2
Hidden Refresh Read	L→H→L	L	L	H	L	ROW/COL	DQ-OUT		*2
Ras#-Only Refresh	L	H	H	X	X	ROW	High-Z		
CBR Refresh	H→L	L	L	X	X	X	High-Z		

Notes:
1. Byte Write cycles LCAS# or UCAS# active.
2. Byte Read cycles LCAS# or UCAS# active.

UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

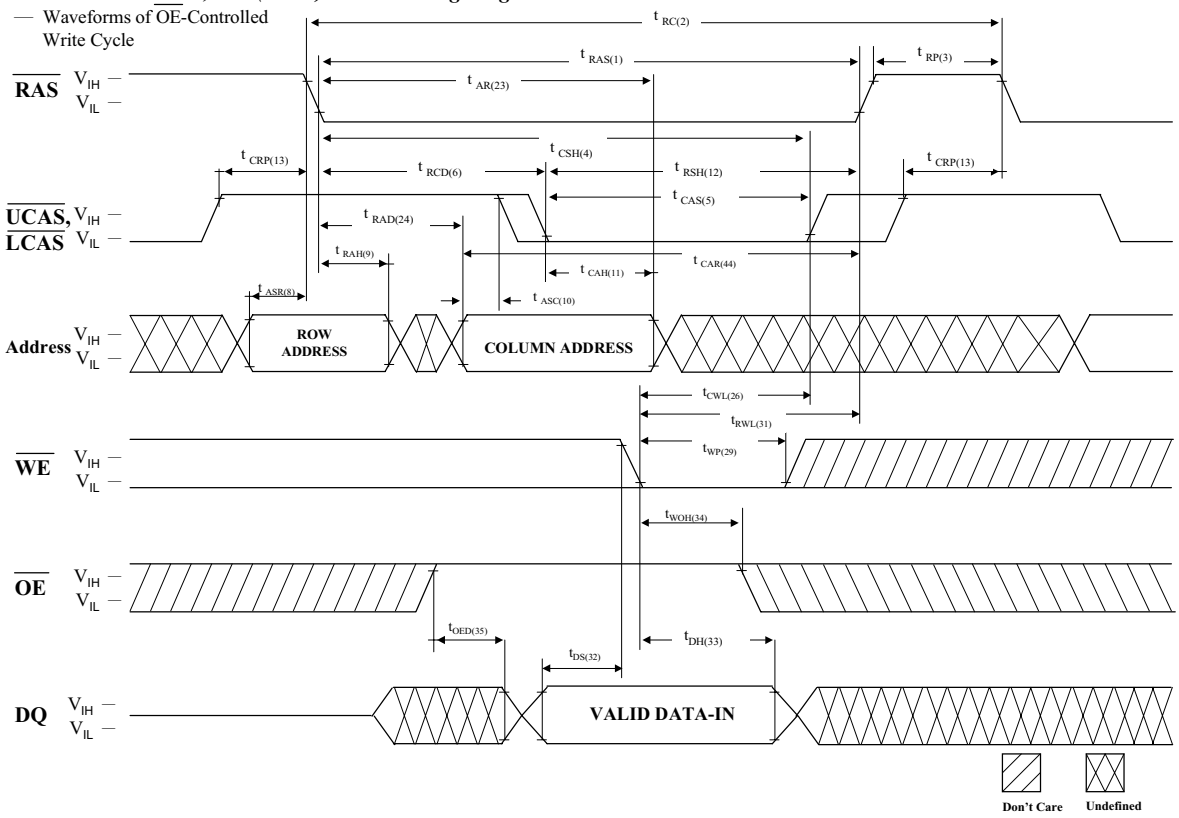


UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

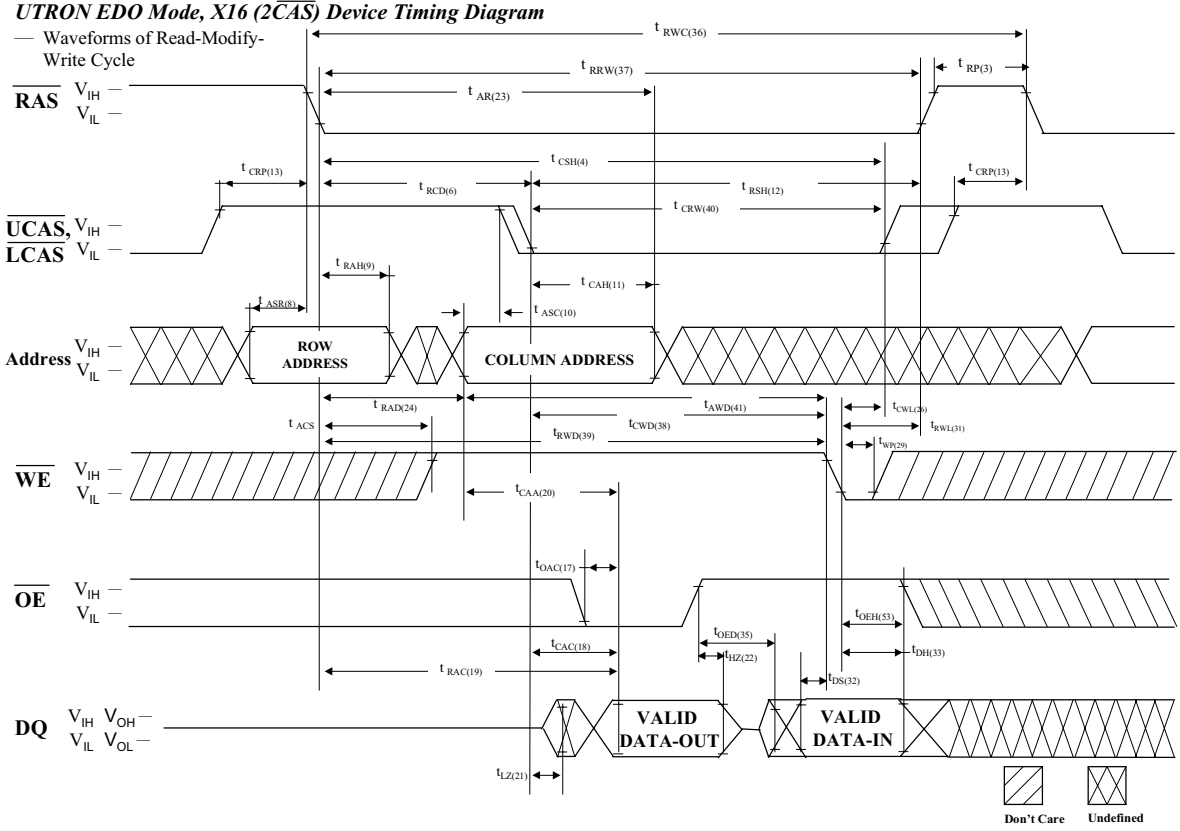


UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

— Waveforms of $\overline{OE}$-Controlled Write Cycle

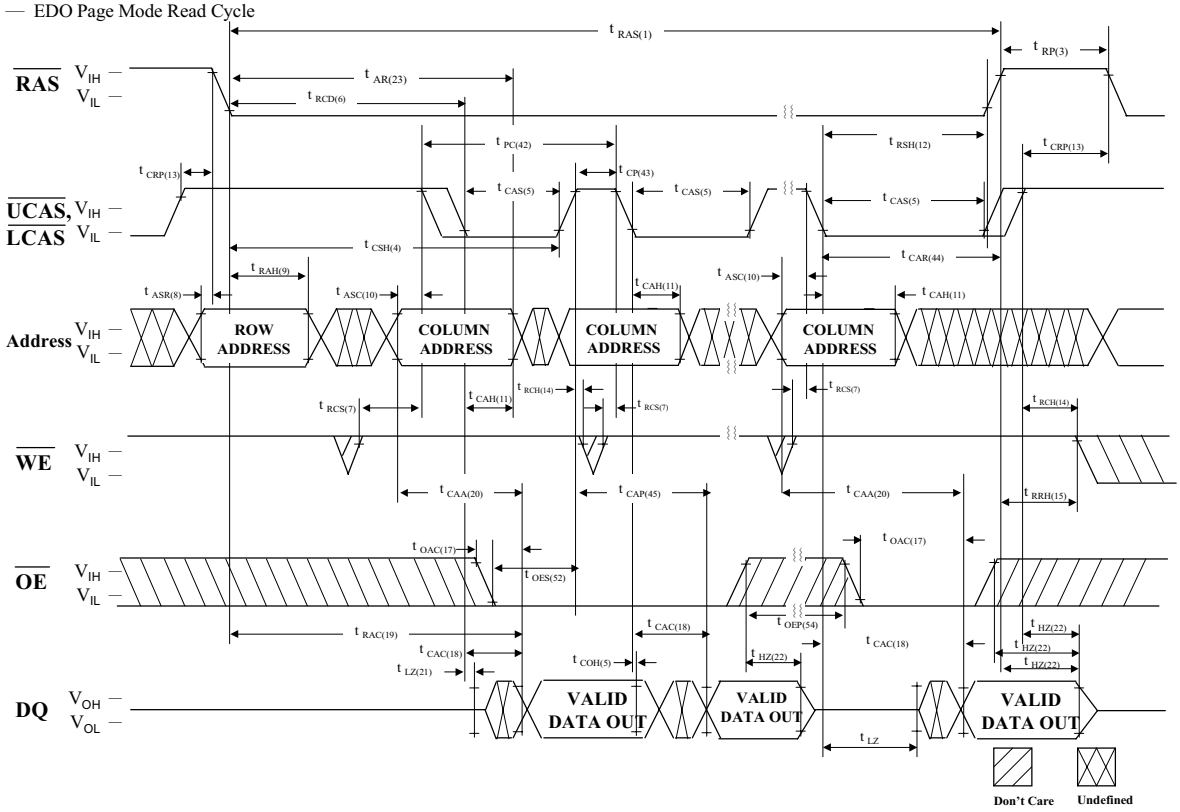


UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram



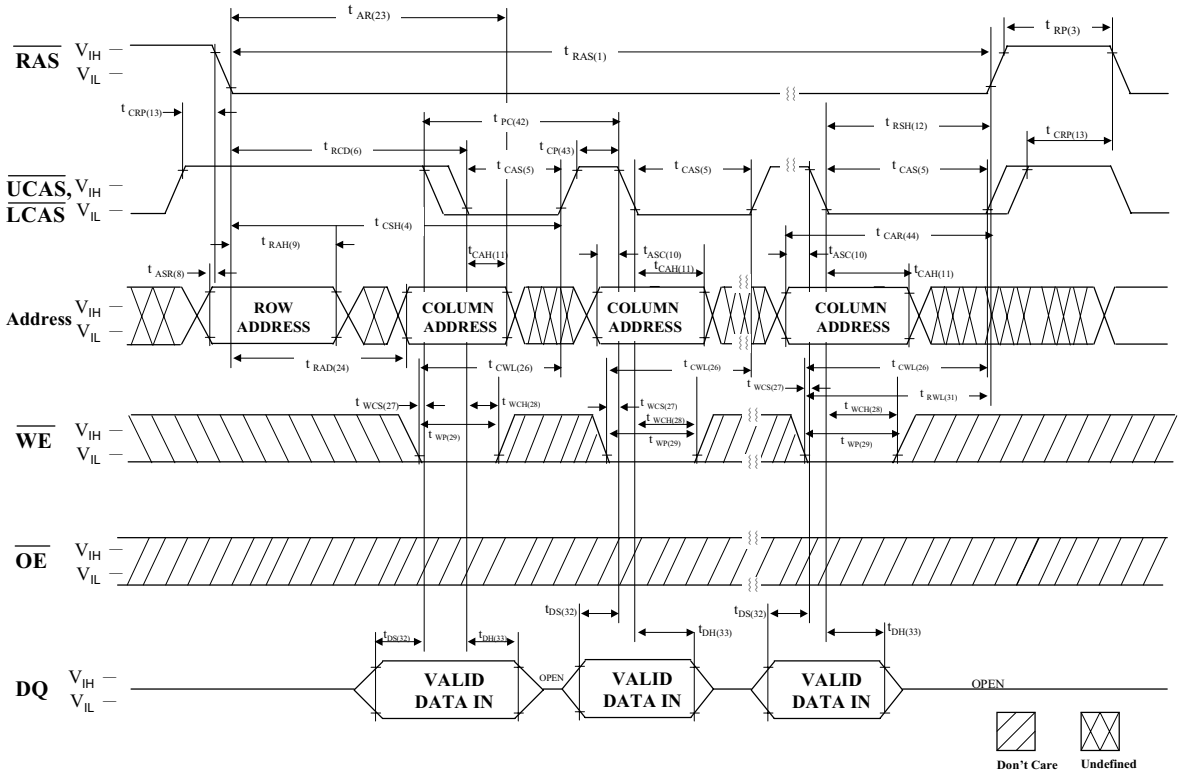
UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

— EDO Page Mode Read Cycle



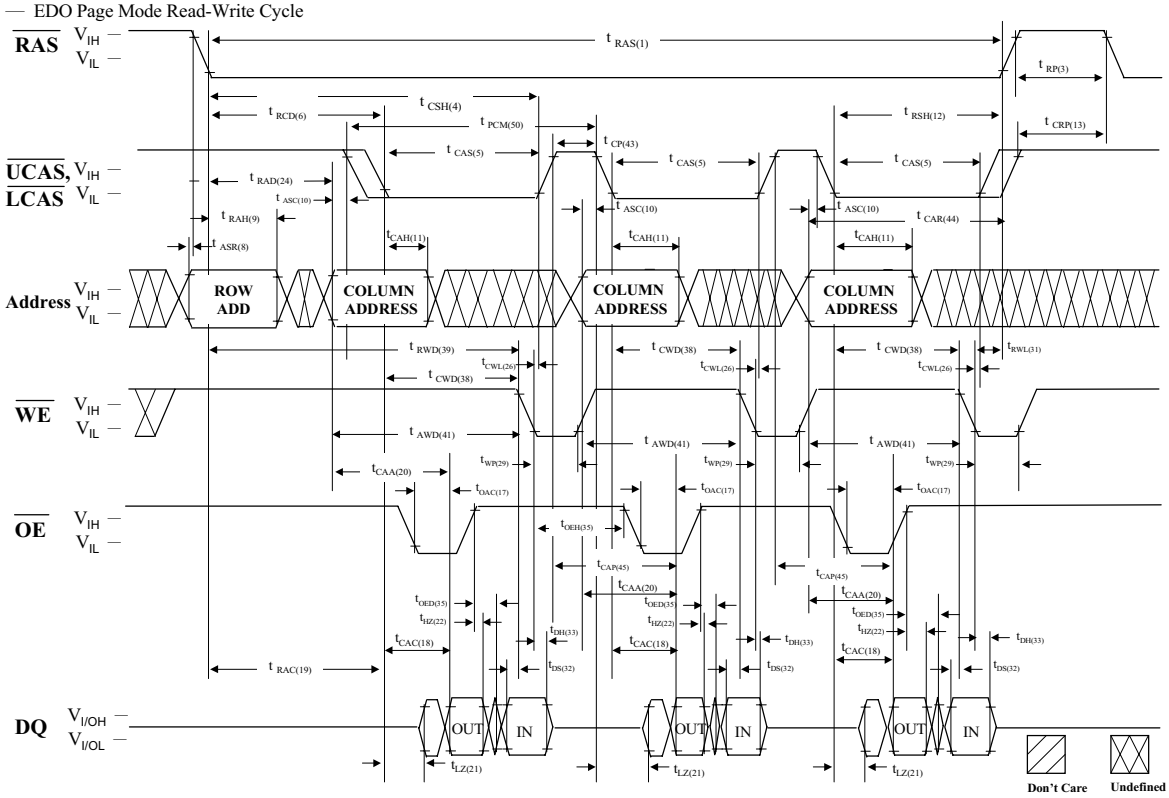
UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

— EDO Page Mode Write Cycle



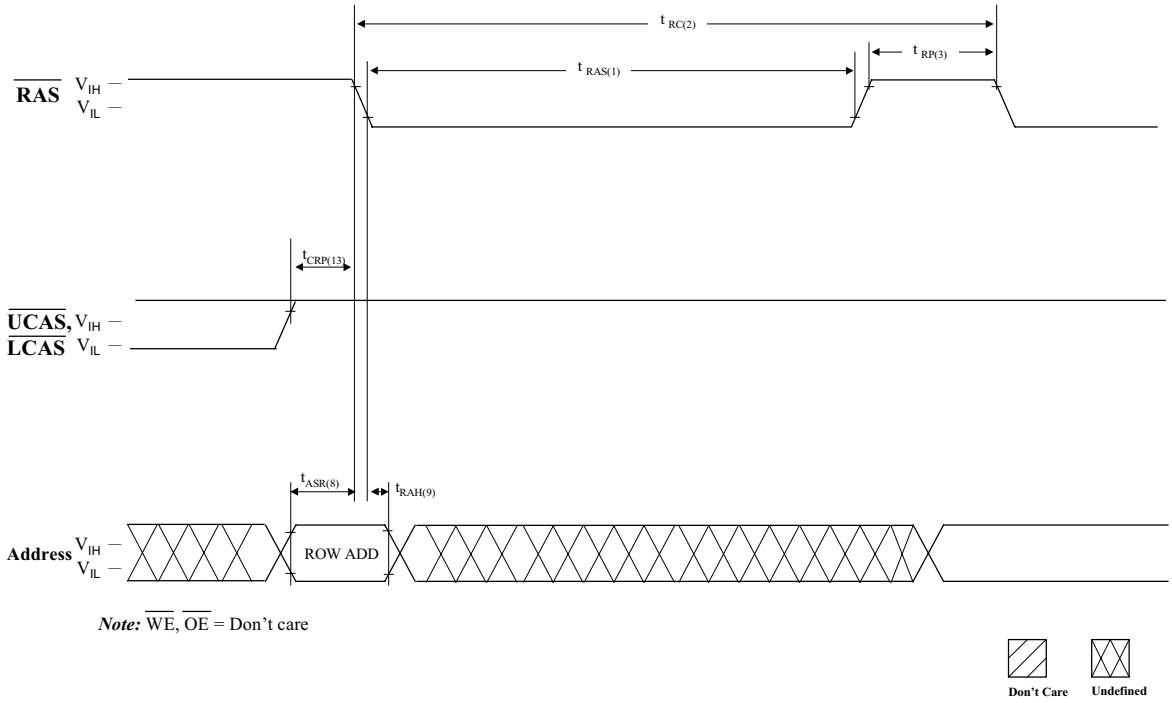
UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

— EDO Page Mode Read-Write Cycle



UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

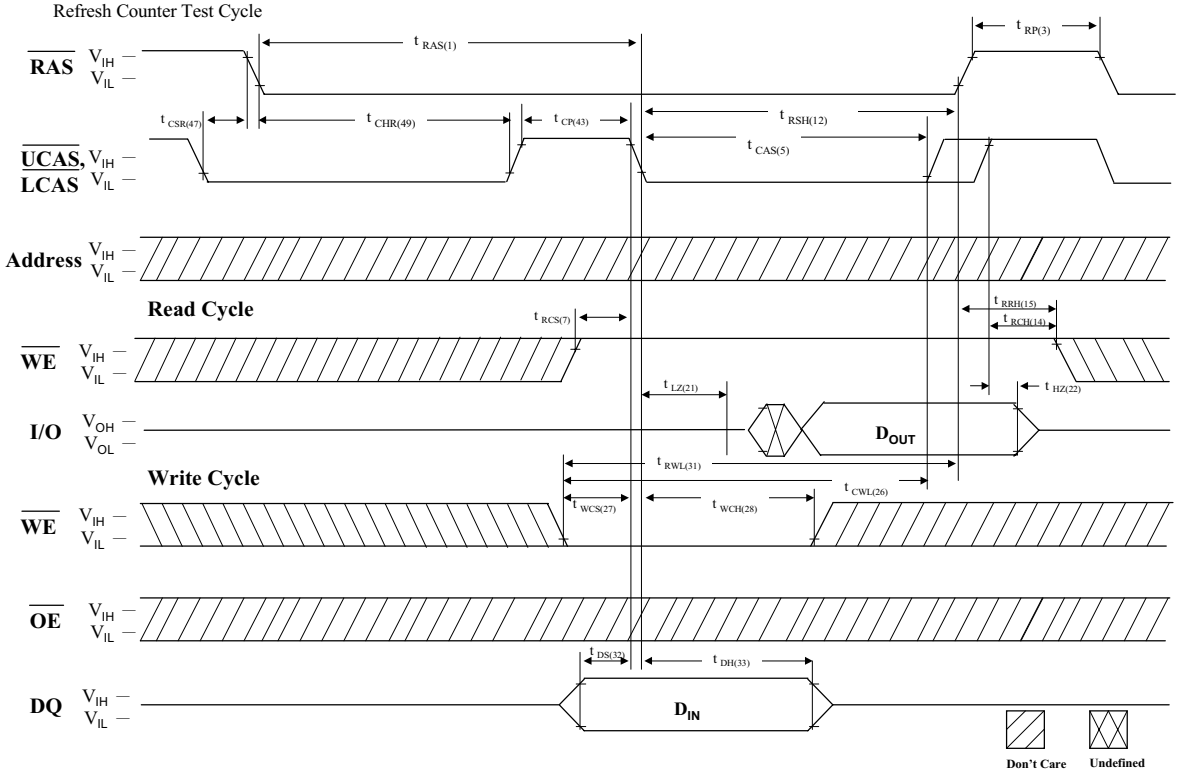
— Waveforms of $\overline{RAS}$-Only Refresh Cycle



Note: $\overline{WE}$, $\overline{OE}$ = Don't care

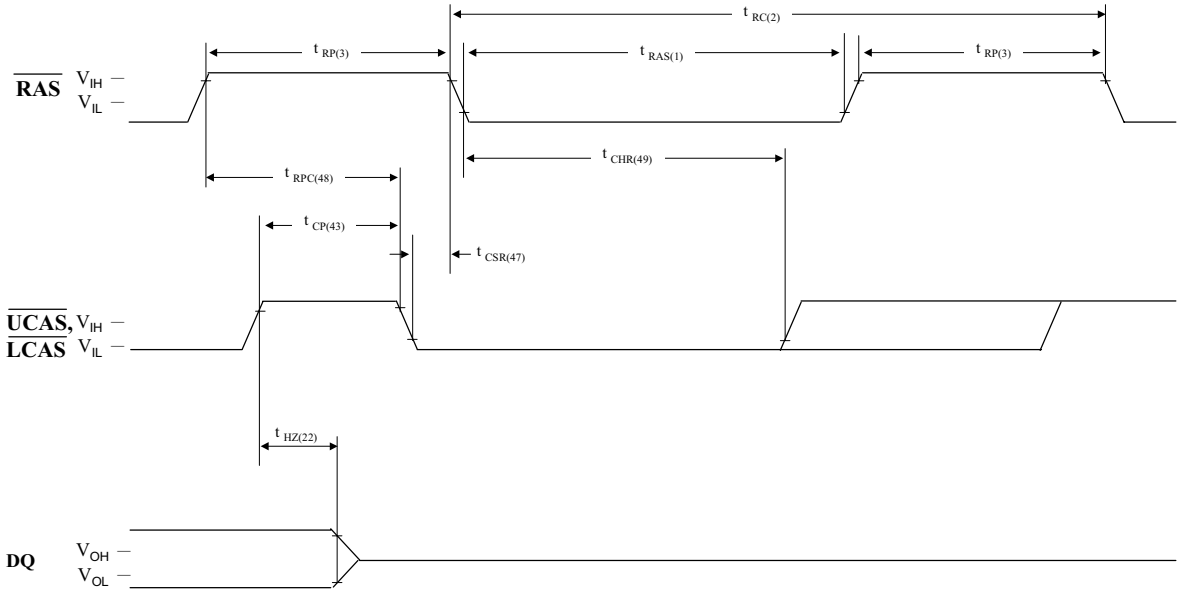
UTRON EDO Mode, X16 (2CAS) Device Timing Diagram

— Waveforms of CAS-before-RAS
Refresh Counter Test Cycle



UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

— Waveforms of $\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle

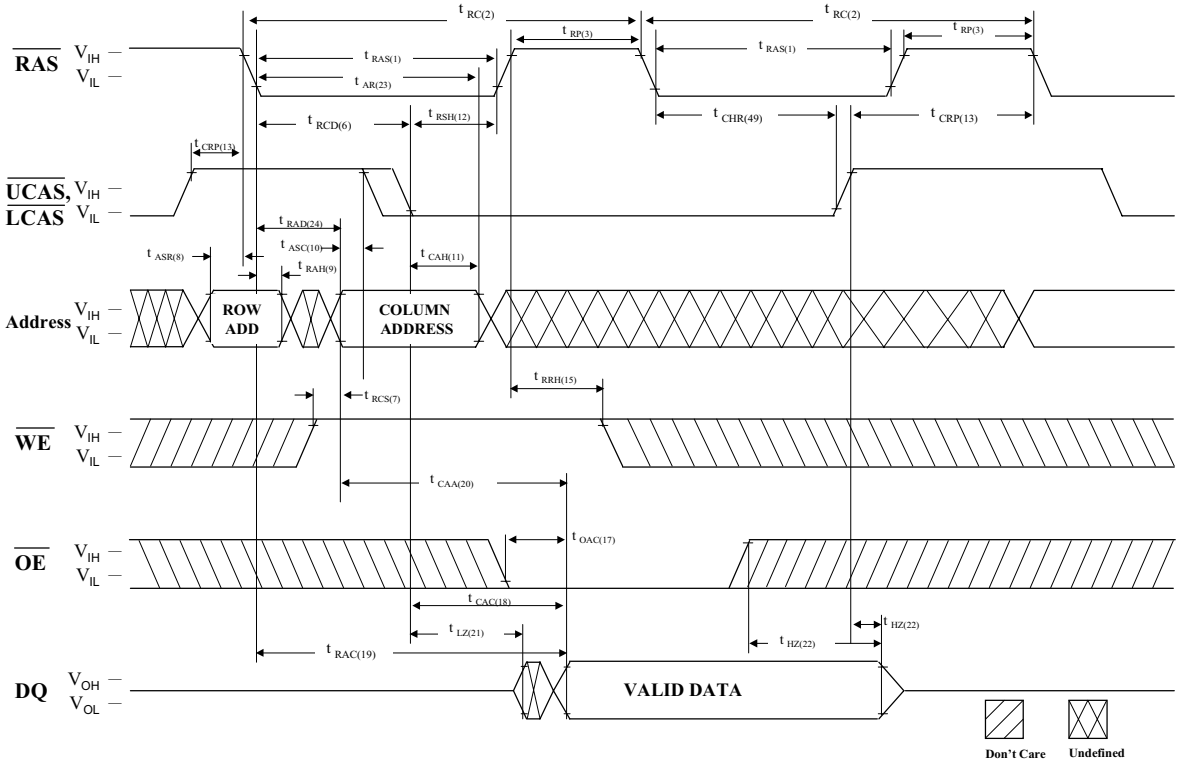


Note: WE, OE = A_0 - A_8 = Don't care

Don't Care Undefined

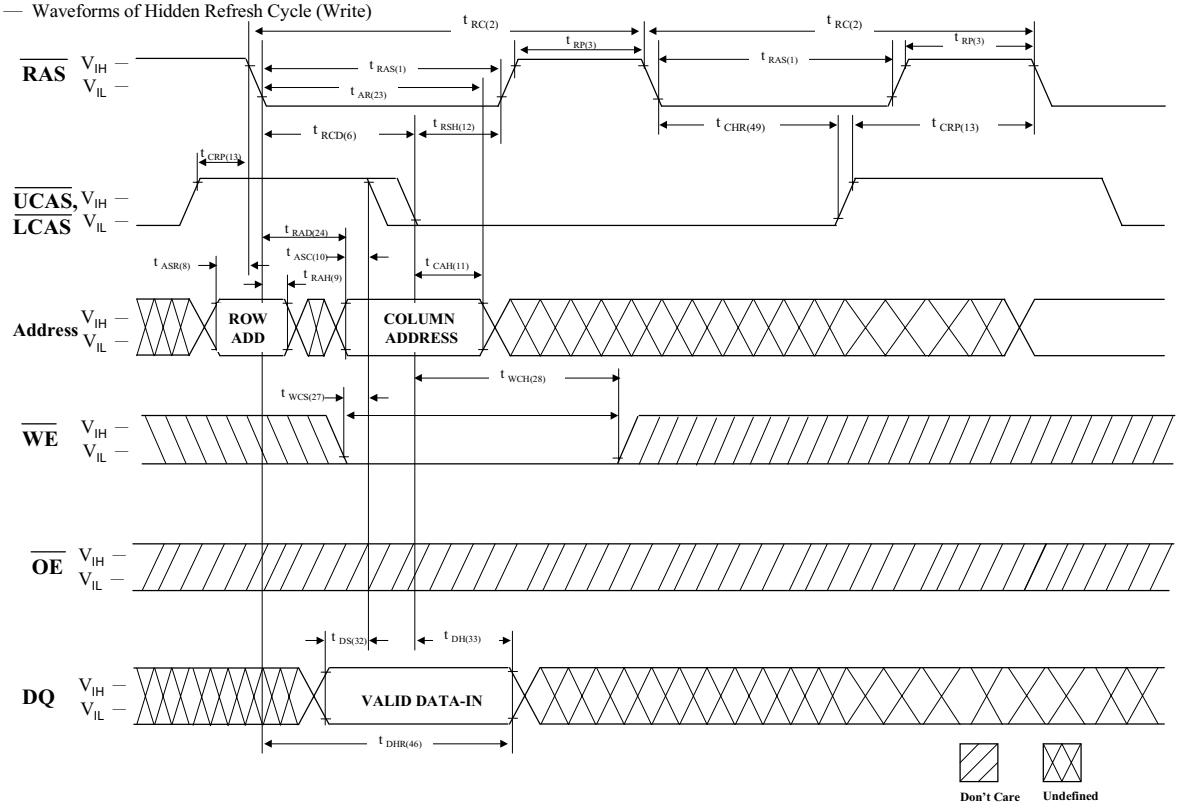
UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

— Waveforms of Hidden Refresh Cycle (Read)



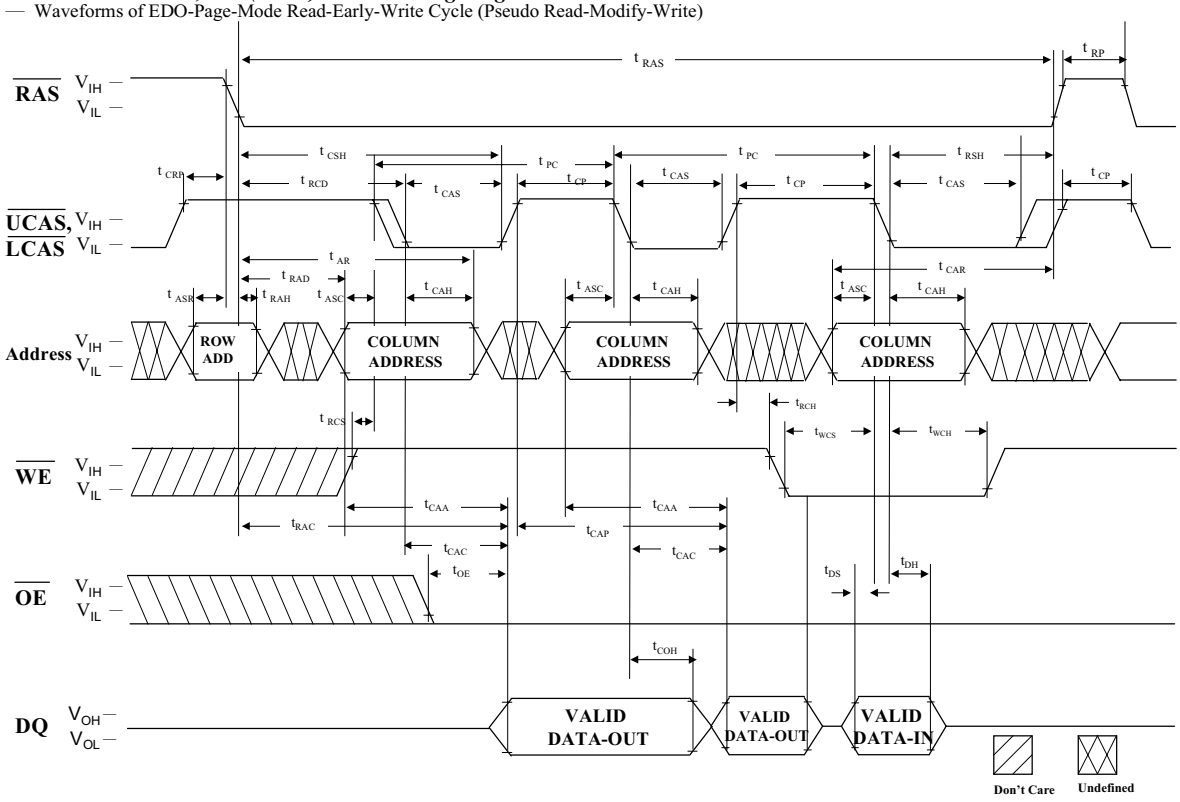
UTRON EDO Mode, X16 (2CAS) Device Timing Diagram

— Waveforms of Hidden Refresh Cycle (Write)



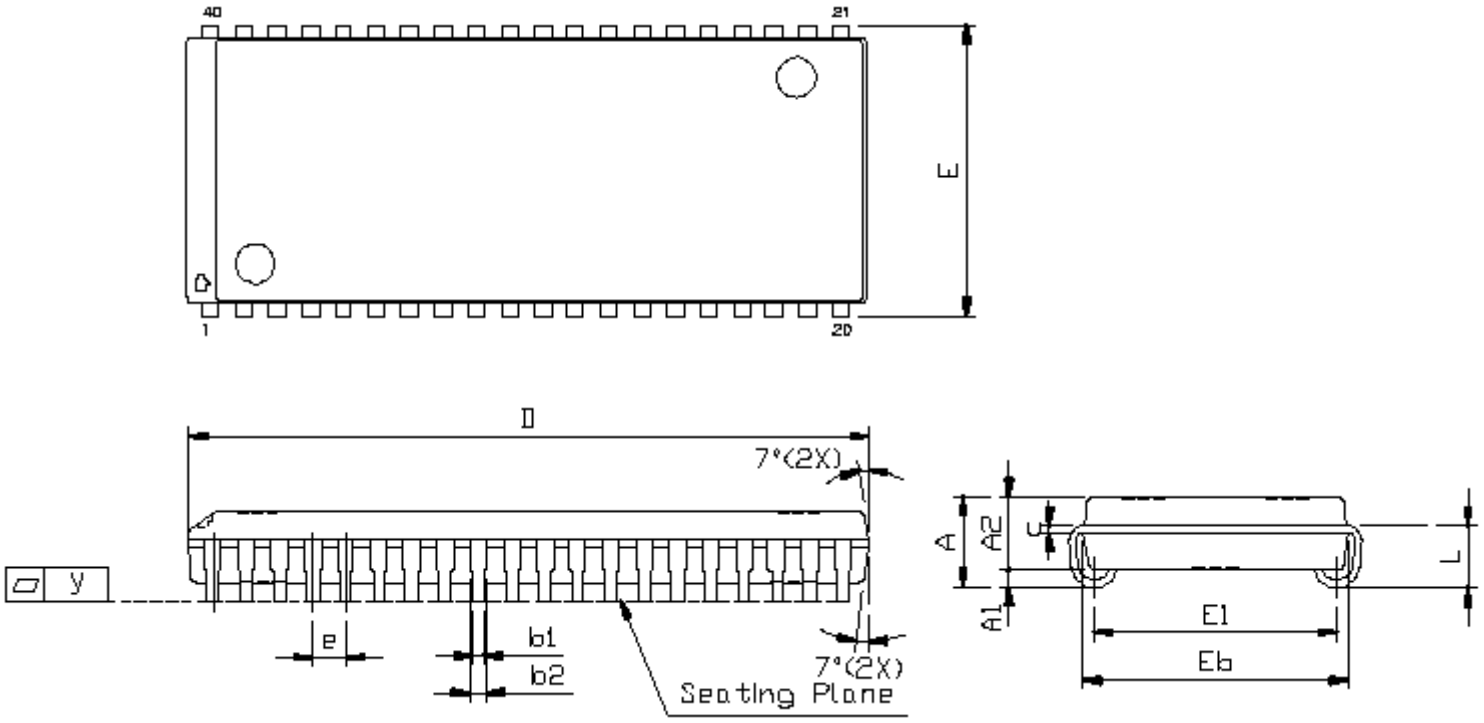
UTRON EDO Mode, X16 (2$\overline{CAS}$) Device Timing Diagram

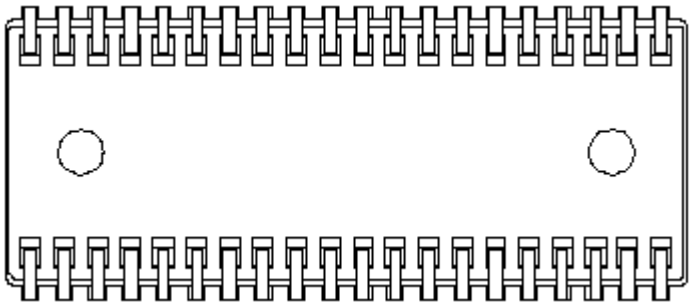
— Waveforms of EDO-Page-Mode Read-Early-Write Cycle (Pseudo Read-Modify-Write)



PACKAGE OUTLINE DIMENSION

40 pin 400mil SOJ Package Outline Dimension

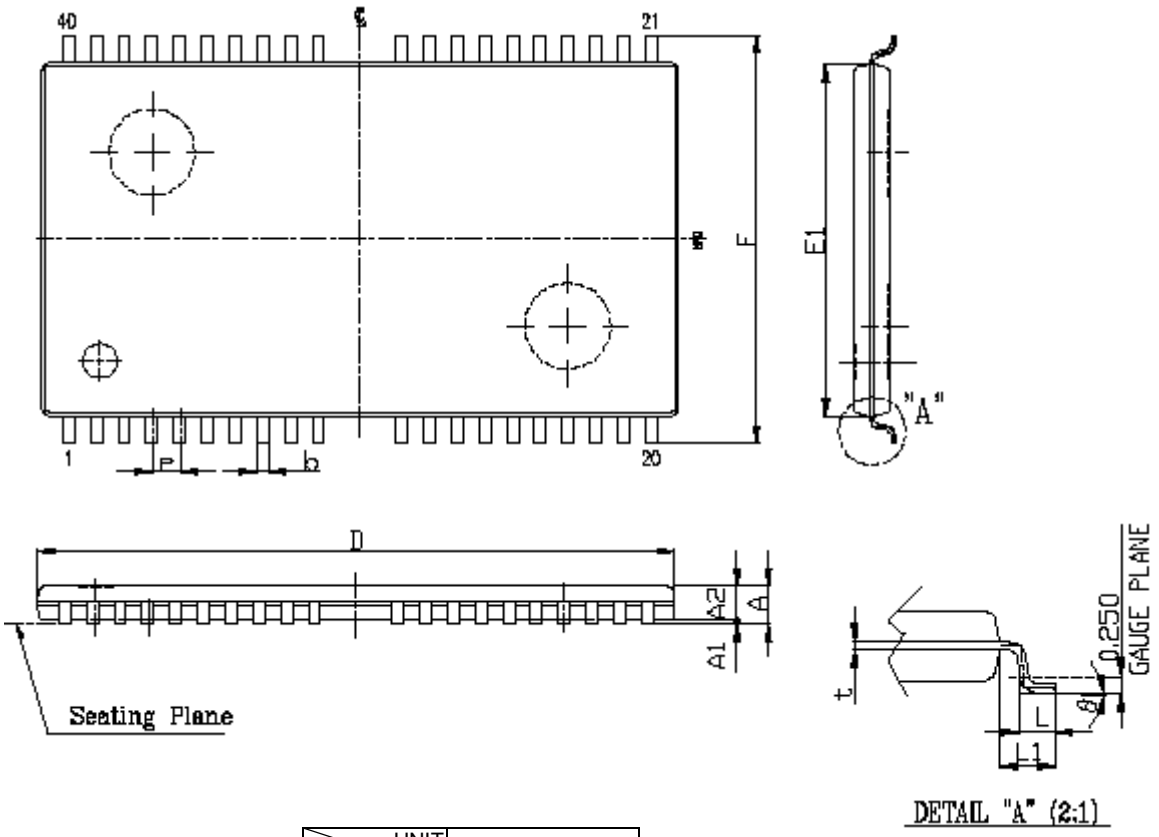




SYMBOL \ UNIT	INCH(BASE)	MM(REF)
A	0.148 (MA)	3.759 (MAX)
A1	0.024(MIN)	0.061(MIN)
A2	0.115(MAX)	2.921(MAX)
b1	0.018 (TYP)	0.457(TYP)
b2	0.025 (TYP)	0.635(TYP)
c	0.010 (TYP)	0.254 (TYP)
D	1.025± 0.004	26.035± 0.102
E	0.440± 0.010	11.176± 0.254
E1	0.38 (MAX)	9.652 (MAX)
Eb	0.400± 0.004	10.16± 0.102
e	0.050 (TYP)	1.27 (TYP)
L	0.093± 0.006	2.362± 0.152
y	0.004(MAX)	0.101 (MAX)

Material: Plastics

40/44 pin 400mil TSOP-II Package Outline Dimension



SYMBOL \ UNIT	MM(BASE)
A	1.20 (MAX)
A1	0.10± 0.05
A2	1.00± 0.05
b	0.30～0.45
t	0.13 (TYP)
D	18.41± 0.10
E1	10.16± 0.10
E	11.76± 0.20
e	0.80(TYP)
L	0.50± 0.10
L1	0.80 (REF)
Θ	0^0～8^0

ORDERING INFORMATION

PART NO.	ACCESS TIME (ns)	PACKAGE
UT51C164JC-35	35	40PIN SOJ
UT51C164JC-40	40	40PIN SOJ
UT51C164JC-50	50	40PIN SOJ
UT51C164JC-60	60	40PIN SOJ
UT51C164MC-35	35	40PIN TSOP-Ⅱ
UT51C164MC-40	40	40PIN TSOP-Ⅱ
UT51C164MC-50	50	40PIN TSOP-Ⅱ
UT51C164MC-60	60	40PIN TSOP-Ⅱ
UT51L164JC-35	35	40PIN SOJ
UT51L164JC-40	40	40PIN SOJ
UT51L164JC-50	50	40PIN SOJ
UT51L164JC-60	60	40PIN SOJ
UT51L164MC-35	35	40PIN TSOP-Ⅱ
UT51L164MC-40	40	40PIN TSOP-Ⅱ
UT51L164MC-50	50	40PIN TSOP-Ⅱ
UT51L164MC-60	60	40PIN TSOP-Ⅱ

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