



GLT440L16

256K X 16 CMOS DYNAMIC RAM WITH EXTENDED DATA OUTPUT

Nov. 2004 (Rev.2.6)

Features :

- * 262,144 words by 16 bits organization.
- * Fast access time and cycle time.
- * Dual $\overline{\text{CAS}}$ Input.
- * Low power dissipation.
- * Read-Modify-Write, $\overline{\text{RAS}}$ -Only Refresh, $\overline{\text{CAS}}$ -Before- $\overline{\text{RAS}}$ Refresh, Hidden Refresh and Test Mode Capability.
- * 512 refresh cycles per 8ms.
- * Available in 40-Pin 400 mil SOJ and 40/44 Pin TSOP(II)
- * Single $+3.3\text{V}\pm 10\%$ Power Supply.
- * All inputs and Outputs are TTL compatible.
- * Extended Data-Out(EDO) Page Mode operation.
- * Self – refresh capability. (S-Version).

Description :

The GLT440L16 is a 262,144 x 16 bit high-performance CMOS dynamic random access memory. The GLT440L16 offers Fast Page mode with Extended Data Output, and has both BYTE WRITE and WORD WRITE access cycles via two $\overline{\text{CAS}}$ pins. The GLT440L16 has symmetric address and accepts 512-cycle refresh in 8ms interval.

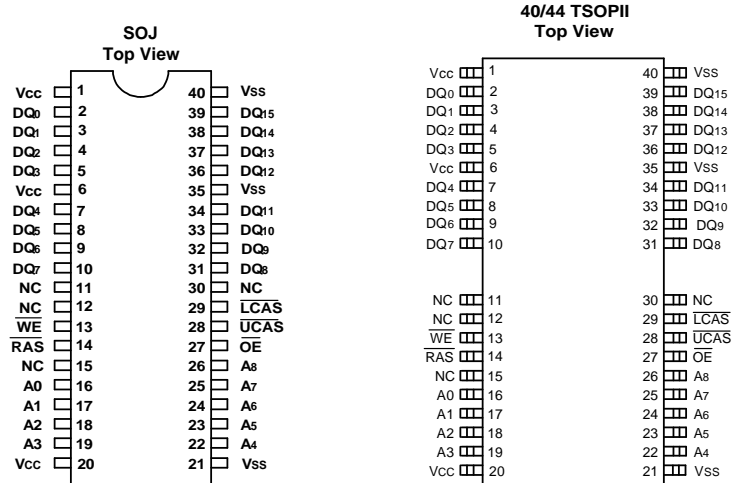
All inputs are TTL compatible. EDO Page Mode operation allows random access up to 512 x 16 bits within a page, with cycle time as short as 14ns.

The GLT440L16 is best suited for graphics, and DSP applications requiring high performance memories.

HIGH PERFORMANCE	35	40	50	60
Max. $\overline{\text{RAS}}$ Access Time, (t_{RAC})	35 ns	40 ns	50 ns	60 ns
Max. Column Address Access Time, (t_{CAA})	18 ns	20 ns	25 ns	30 ns
Min. Extended Data Out Page Mode Cycle Time, (t_{PC})	14 ns	15 ns	19 ns	25 ns
Min. Read/Write Cycle Time, (t_{RC})	45 ns	75 ns	90 ns	104 ns
Max. $\overline{\text{CAS}}$ Access Time, (t_{CAC})	11 ns	12 ns	13 ns	15 ns

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Pin Configuration :

Pin Descriptions:

Name	Function
A ₀ - A ₈	Address Inputs
$\overline{\text{RAS}}$	Row Address Strobe
$\overline{\text{UCAS}}$	Column Address Strobe/Upper Byte Control
$\overline{\text{LCAS}}$	Column Address Strobe/Lower Byte Control
$\overline{\text{WE}}$	Write Enable
$\overline{\text{OE}}$	Output Enable
DQ ₀ - DQ ₁₅	Data Inputs / Outputs
V _{CC}	+3.3V Power Supply
V _{SS}	0V Supply
NC	No Connection

Absolute Maximum Ratings*

Operating Temperature, T_A (ambient)
-10°C to +70°C
 Storage Temperature(plastic).....-55°C to +150°C
 Voltage Relative to V_{SS}-1.0V to + 4.6V
 Short Circuit Output Current.....50mA
 Power Dissipation.....1.0W

Capacitance*

$T_A=25^\circ\text{C}$, $V_{CC}=3.3\text{V}\pm 10\%$, $V_{SS}=0\text{V}$

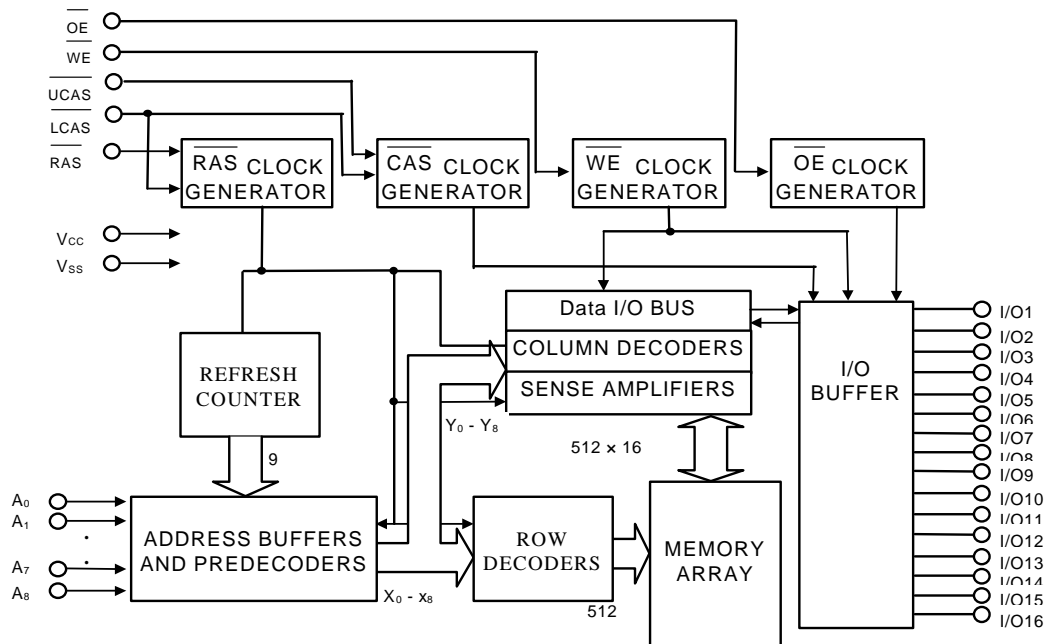
Symbol	Parameter	Typ	Max.	Unit
C_{IN1}	Address Input	3	4	pF
C_{IN2}	$\overline{\text{RAS}}$, $\overline{\text{LCAS}}$, $\overline{\text{UCAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$	4	5	pF
C_{OUT}	Data Input/Output	5	7	pF

*Note: Operation above Absolute Maximum Ratings can adversely affect device reliability.

*Note: Capacitance is sampled and not 100% tested

Electrical Specifications

- CAS means $\overline{\text{UCAS}}$ and $\overline{\text{LCAS}}$.
- All voltages are referenced to GND.
- After power up, wait more than 100 μs and then, execute eight $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ or $\overline{\text{RAS}}$ -only refresh cycles as dummy cycles to initialize internal circuit.

Block Diagram :


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Truth Table: GLT440L16

Function	RAS	CASL	CASH	WE	OE	ADDRESS	DQs	Notes	
Standby	H	H	H	X	X		High-Z		
Read: Word	L	L	L	H	L	ROW/COL	Data Out		
Read: Lower Byte	L	L	H	H	L	ROW/COL	Lower Byte,Data-Out Upper Byte,High-Z		
Read: Upper Byte	L	H	L	H	L	ROW/COL	Lower Byte,High-Z Upper Byte,Data-Out		
Write: Word(Early Write)	L	L	L	L	X	ROW/COL	Data-In		
Write: Lower Byte (Early)	L	L	H	L	X	ROW/COL	Lower Byte,Data-In Upper Byte,High-Z		
Write: Upper Byte (Early)	L	H	L	L	X	ROW/COL	Lower Byte,High-Z Upper Byte,Data-In		
Read Write	L	L	L	H→L	L→H	ROW/COL	Data-Out,Data-In	1,2	
EDO-Page- Mode Read	1st Cycle	L	H→L	H→L	H	L	ROW/COL	Data-Out	2
	2nd Cycle	L	H→L	H→L	H	L	COL	Data-Out	2
EDO-Page- Mode Write	1st Cycle	L	H→L	H→L	L	X	ROW/COL	Data-In	2
	2nd Cycle	L	H→L	H→L	L	X	COL	Data-In	2
EDO-Page- Mode Read- Write	1st Cycle	L	H→L	H→L	H→L	L→H	ROW/COL	Data-Out,Data-In	1,2
	2nd Cycle	L	H→L	H→L	H→L	L→H	COL	Data-Out,Data-In	1,2
Hidden Refresh	Read	L→H→L	L	L	H	L	ROW/COL	Data-Out	2
	Write	L→H→L	L	L	H	L	ROW/COL	Data-In	2
RAS-Only Refresh	L	H	H	X	X	ROW	High-Z		
CBR Refresh	H→L	L	L	X	X		High-Z	3	

Notes:

1. These READ cycles may also be BYTE READ cycles (either \overline{UCAS} or \overline{LCAS} active).
2. These WRITE cycles may also be BYTE WRITE cycles (either \overline{UCAS} or \overline{LCAS} active).
3. EARLY WRITE only.
4. At least one of the two CAS signals must be active (\overline{UCAS} or \overline{LCAS}).

DC and Operating Characteristics (1-2)
 $T_A = 0^\circ\text{C to } 70^\circ\text{C}$, $V_{CC}=3.3\text{V}\pm 10\%$, $V_{SS}=0\text{V}$, unless otherwise specified.

Sym.	Parameter	Test Conditions	Access Time	Min.	Typ	Max.	Unit	Notes
I_{LI}	Input Leakage Current (any input pin)	$0\text{V} \leq V_{IN} \leq 5.5\text{V}$ (All other pins not under test=0V)		-10		+10	μA	
I_{LO}	Output Leakage Current (for High-Z State)	$0\text{V} \leq V_{out} \leq 5.5\text{V}$ Output is disabled (Hiz)		-10		+10	μA	
I_{CC1}	Operating Current, Random READ/WRITE	$t_{RC} = t_{RC} (\text{min.})$	$t_{RAC} = 35\text{ns}$ $t_{RAC} = 40\text{ns}$ $t_{RAC} = 50\text{ns}$ $t_{RAC} = 60\text{ns}$			160 145 125 110	mA	1,2
I_{CC2}	Standby Current,(TTL)	$\overline{\text{RAS}}$, $\overline{\text{UCAS}}$, $\overline{\text{LCAS}}$ at V_{IH} other inputs $\geq V_{SS}$				4	mA	
I_{CC3}	Refresh Current, RAS-Only	$\overline{\text{RAS}}$ cycling, $\overline{\text{UCAS}}$, $\overline{\text{LCAS}}$ at V_{IH} $t_{RC} = t_{RC} (\text{min.})$	$t_{RAC} = 35\text{ns}$ $t_{RAC} = 40\text{ns}$ $t_{RAC} = 50\text{ns}$ $t_{RAC} = 60\text{ns}$			160 145 125 110	mA	2
I_{CC4}	Operating Current, EDO Page Mode	$\overline{\text{RAS}}$ at V_{IL} , $\overline{\text{UCAS}}$, $\overline{\text{LCAS}}$ address cycling: $t_{PC}=t_{PC}(\text{min.})$	$t_{RAC} = 35\text{ns}$ $t_{RAC} = 40\text{ns}$ $t_{RAC} = 50\text{ns}$ $t_{RAC} = 60\text{ns}$			160 145 125 110	mA	1,2
I_{CC5}	Refresh Current, CAS Before RAS	$\overline{\text{RAS}}$, $\overline{\text{UCAS}}$, $\overline{\text{LCAS}}$ address cycling: $t_{RC}=t_{RC} (\text{min.})$	$t_{RAC} = 35\text{ns}$ $t_{RAC} = 40\text{ns}$ $t_{RAC} = 50\text{ns}$ $t_{RAC} = 60\text{ns}$			160 145 125 110	mA	1
I_{CC6}	Standby Current, (CMOS)	$\overline{\text{RAS}} \geq V_{CC}-0.2\text{V}$, $\overline{\text{UCAS}} \geq V_{CC}-0.2\text{V}$, $\overline{\text{LCAS}} \geq V_{CC}-0.2\text{V}$, All other inputs V_{SS}				1	mA	
I_{CC7}	Self refresh Current	$\overline{\text{RAS}} = \overline{\text{CAS}} = 0.2\text{V}$, $\overline{\text{WE}} = \overline{\text{OE}} = A_0 \sim A_{10} = V_{CC}-0.2\text{V}$ or 0.2V $\overline{\text{DQ}_0} \sim \overline{\text{DQ}_3} = V_{CC}-0.2\text{V}$ or Open				300	μA	1,5
V_{CC}	Supply Voltage			3.0		3.6	V	
V_{IL}	Input Low Voltage			-0.3		0.8	V	3
V_{IH}	Input High Voltage			2.0V		$V_{CC}+0.3$	V	3
V_{OL}	Output Low Voltage	$I_{OL} = 2\text{mA}$				0.4	V	
V_{OH}	Output High Voltage	$I_{OH} = -2\text{mA}$		2.4			V	

Notes:

- I_{CC} is dependent on output loading when the device output is selected. Specified $I_{CC}(\text{max.})$ is measured with the output open.
- I_{CC} is dependent upon the number of address transitions specified $I_{CC}(\text{max.})$ is measured with a maximum of one transition per address cycle in random Read/Write and EDO Fast Page Mode.
- Specified $V_{IL}(\text{min.})$ is steady state operation. During transitions $V_{IL}(\text{min.})$ may undershoot to -0.3V for a period not to exceed 20ns. All AC parameters are measured with $V_{IL}(\text{min.}) \geq V_{SS}$ and $V_{IH}(\text{max.}) \leq V_{CC}$.
- S-Version.

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AC Characteristics

$T_A = 0^\circ\text{C}$ to 70°C , $V_{CC} = 3.3\text{ V} \pm 10\%$ $V_{IH}/V_{IL} = 2.0/0.8\text{V}$, $V_{OH}/V_{OL} = 2.0/0.8\text{V}$

An initial pause of 100 μs and 8 CAS-before-RAS or RAS-only refresh cycles are required after power-up.

Parameter	Symbol	35		40		50		60		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Read or Write Cycle Time	t_{RC}	70		75		90		104		ns	
Read Modify write Cycle Time	t_{RWC}	90		93		109		140		ns	
RAS Precharge Time	t_{RP}	25		25		30		40		ns	
RAS Pulse Width	t_{RAS}	35	75k	40	100k	50	100k	60	10k	ns	
Access Time from $\overline{\text{RAS}}$	t_{RAC}		35		40		50		60	ns	1,2,3
Access Time from $\overline{\text{CAS}}$	t_{CAC}		11		12		13		15	ns	1,5,10
Access Time from Column Address	t_{AA}		18		20		25		30	ns	1,5,6
CAS to Output Low-Z	t_{CLZ}	0		0		0		3		ns	
CAS to Output High-Z	t_{CEZ}	3	8	3	8	3	8	3	15	ns	
RAS Hold Time	t_{RSH}	10		12		14		15		ns	
RAS Hold Time Referenced to OE	t_{ROH}	7		8		9		10		ns	
CAS Hold Time	t_{CSH}	34		34		45		45		ns	
CAS Pulse width	t_{CAS}	6		6		8		10	10k	ns	
RAS to CAS Delay Time	t_{RCD}	13	24	18	28	19	37	20	45	ns	
RAS to Column Address Delay Time	t_{RAD}	10	17	13	20	14	25	15	30	ns	7
CAS to RAS Precharge Time	t_{CRP}	5		5		5		5		ns	
Row Address Set-Up Time	t_{ASR}	0		0		0		0		ns	
Row Address Hold Time	t_{RAH}	6		8		9		10		ns	
Column Address Set-Up Time	t_{ASC}	0		0		0		0		ns	
Column Address Hold Time	t_{CAH}	5		6		7		10		ns	
Column Address to RAS Lead Time	t_{RAL}	18		20		25		30		ns	
Column Address Hold Time Referenced to RAS	t_{AR}	25		34		44		45		ns	
Read Command Set-Up Time	t_{RCS}	0		0		0		0		ns	
Read Command Hold Time Referenced to $\overline{\text{CAS}}$	t_{RCH}	0		0		0		0		ns	4
Read Command Hold Time Referenced to RAS	t_{RRH}	0		0		0		0		ns	4
Write Command Set-Up Time	t_{WCS}	0		0		0		0		ns	8,9
Write Command Hold Time	t_{WCH}	5		6		7		10		ns	
Write Command Pulse Width	t_{WP}	5		6		7		10		ns	
Write Command to RAS Lead Time	t_{RWL}	10		12		13		15		ns	

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AC Characteristics

Parameter	Symbol	35		40		50		60		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Write Command to $\overline{\text{CAS}}$ Lead Time	t_{CWL}	8		12		13		13		ns	
Data Set-Up Time	t_{DS}	0		0		0		0		ns	
Data Hold Time	t_{DH}	5		8		9		10		ns	
Data Hold Time Referenced to $\overline{\text{RAS}}$	t_{DHR}	25		36		46		46		ns	
$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ Delay Time	t_{RWD}	46		54		64		79		ns	
$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ Delay Time	t_{CWD}	23		24		25		34		ns	
Column Address to $\overline{\text{WE}}$ Delay Time	t_{AWD}	29		32		37		49		ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Precharge Time	t_{RPC}	0		0		0		0		ns	
Access Time from $\overline{\text{CAS}}$ Precharge	t_{CPA}		20		22		30		35	ns	
EDO Page Mode Cycle Time	t_{PC}	14		15		20		25		ns	
EDO Page Mode Read-Modify-write Cycle Time	t_{PRWC}	45		50		59		59		ns	
$\overline{\text{CAS}}$ Precharge Time (EDO Page Mode)	t_{CP}	4		5		8		10		ns	
$\overline{\text{RAS}}$ Pulse Width (EDO Page Mode Only)	t_{RASP}	35	100k	40	100k	50	100k	60	100k	ns	
Access Time from $\overline{\text{OE}}$	t_{OEA}		11		12		13		15	ns	
$\overline{\text{OE}}$ to Data Delay Time	t_{OED}	5		8		8		15		ns	
$\overline{\text{OE}}$ to Output High-Z	$t_{\text{O EZ}}$	3	8	3	8	3	8	3	8	ns	
$\overline{\text{OE}}$ Command Hold Time	$t_{\text{OE H}}$	5		7		7		15		ns	
Data Output Hold after $\overline{\text{CAS}}$ Low	t_{DOH}	3		3		5		5		ns	
$\overline{\text{RAS}}$ to Output High-Z	t_{REZ}	3	8	3	8	3	8	3	15	ns	
$\overline{\text{WE}}$ to Output High-Z	t_{WEZ}	3	10	3	10	3	12	3	15	ns	
$\overline{\text{OE}}$ to $\overline{\text{CAS}}$ Hold Time	$t_{\text{O CH}}$	8		8		8		5		ns	
$\overline{\text{CAS}}$ Hold Time to $\overline{\text{OE}}$	$t_{\text{C HO}}$	8		8		8		5		ns	
$\overline{\text{OE}}$ Precharge Time	$t_{\text{O EP}}$	8		8		8		5		ns	
$\overline{\text{CAS}}$ Set-Up Time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Cycle	t_{CSR}	8		10		10		10		ns	
$\overline{\text{CAS}}$ Hold Time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Cycle	t_{CHR}	8		10		10		10		ns	
Transition Time	t_{T}	2	50	2	50	2	50	2	50	ns	
Refresh Period	t_{REF}		8		8		8		8	ms	
$\overline{\text{RAS}}$ pulse width ($\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Self refresh)	t_{RASS}	100		100		100		100		μs	
$\overline{\text{RAS}}$ precharge time ($\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Self refresh)	t_{RPS}	70		75		90		110		ns	
$\overline{\text{CAS}}$ precharge time ($\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Self refresh)	t_{CHS}	50		50		50		50		ns	

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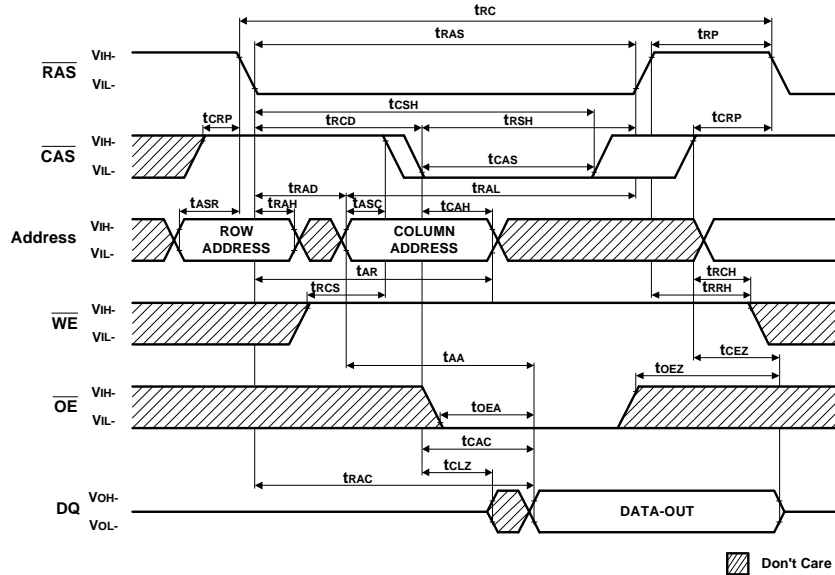
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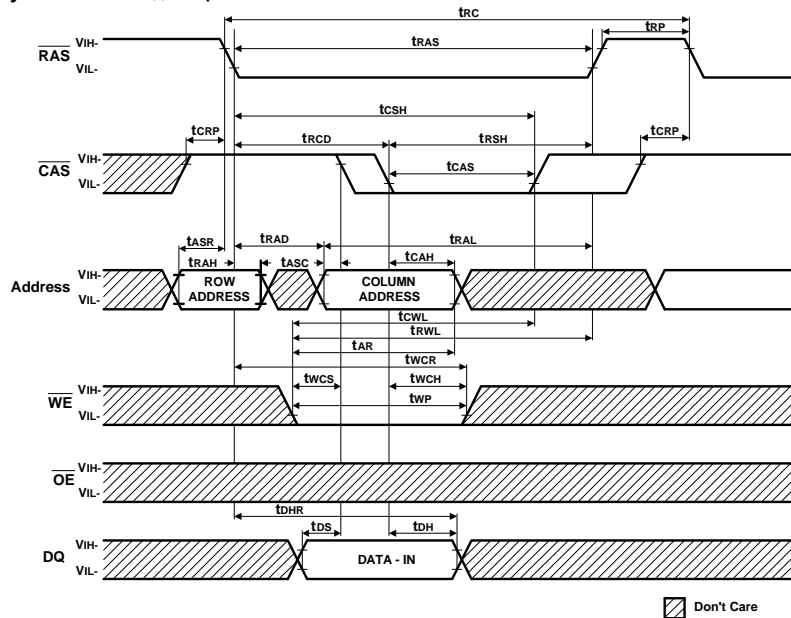
Notes:

1. Measure with a load equivalent to one TTL inputs and 50 pF.
2. Assumes that $t_{RCD} \leq t_{RCD}(\text{max.})$. If t_{RCD} is greater than $t_{RCD}(\text{max.})$, access time will be t_{AA} dominant.
3. Assumes that $t_{RAD} \leq t_{RAD}(\text{max.})$. If t_{RAD} is greater than $t_{RCD}(\text{max.})$, access time will be controlled by t_{CAC} .
4. Either t_{RRH} or t_{RCH} must be satisfied for a Read Cycle.
5. Access time is determined by the longest of t_{CAA} , t_{CAC} and t_{CPA} .
6. Assumes that $t_{RAD} \geq t_{RAD}(\text{max.})$.
7. Operation within the $t_{RAD}(\text{max.})$ limit ensures that $t_{RAC}(\text{max.})$ can be met. $t_{RAD}(\text{max.})$ is specified as a reference point only. If t_{RAD} is greater than the specified $t_{RAD}(\text{max.})$ limit, the access time is controlled by t_{CAA} and t_{CAC} .
8. t_{WCS} , t_{RWD} , t_{AWD} and t_{CWD} are not restrictive operating parameters.
9. $t_{WCS}(\text{min.})$ must be satisfied in an Early Write Cycle.
10. t_{DS} and t_{DH} are referenced to the latter occurrence of $\overline{\text{CAS}}$ of $\overline{\text{WE}}$. t_T is measured between $V_{IH}(\text{min.})$ and $V_{IL}(\text{max.})$. AC-measurements assume $t_T = 1.5 \text{ ns}$.

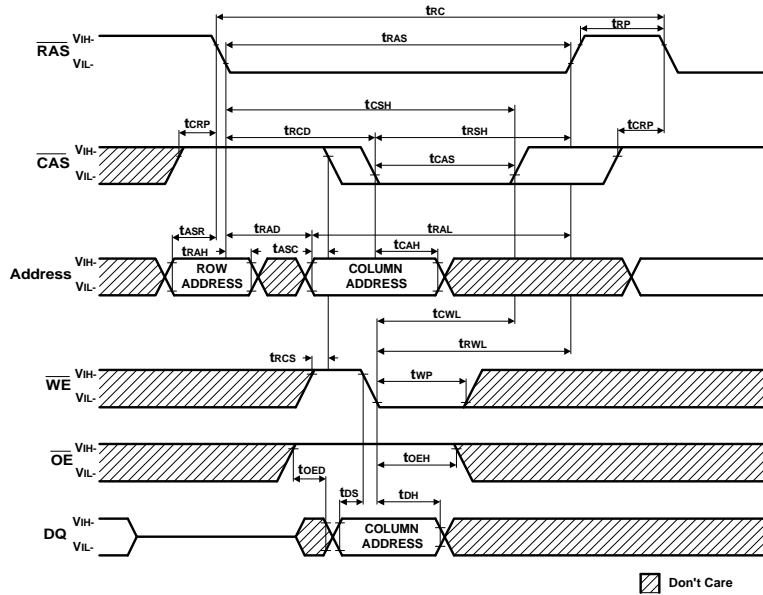
Read Cycle



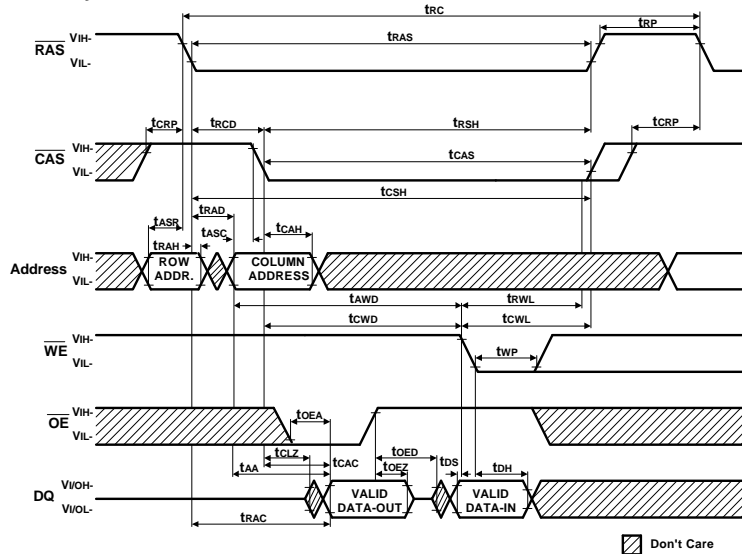
Early Write Cycle NOTE : D_{OUT} = Open



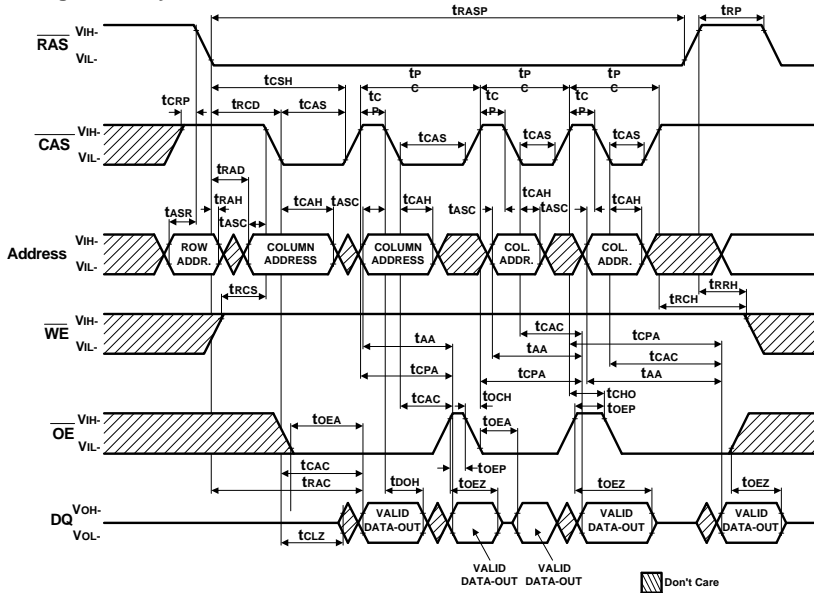
Late Write Cycle (OE Controlled Write) NOTE : D_{OUT} = Open



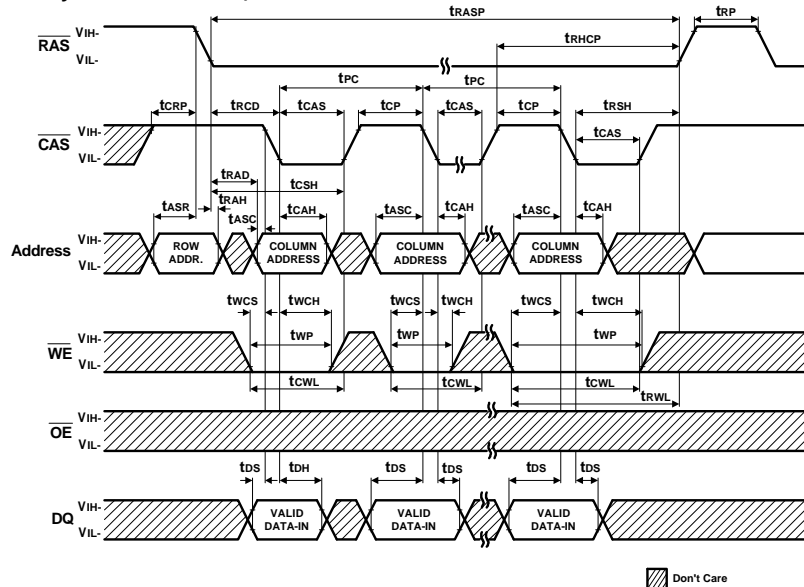
Read - Modify - Write Cycle



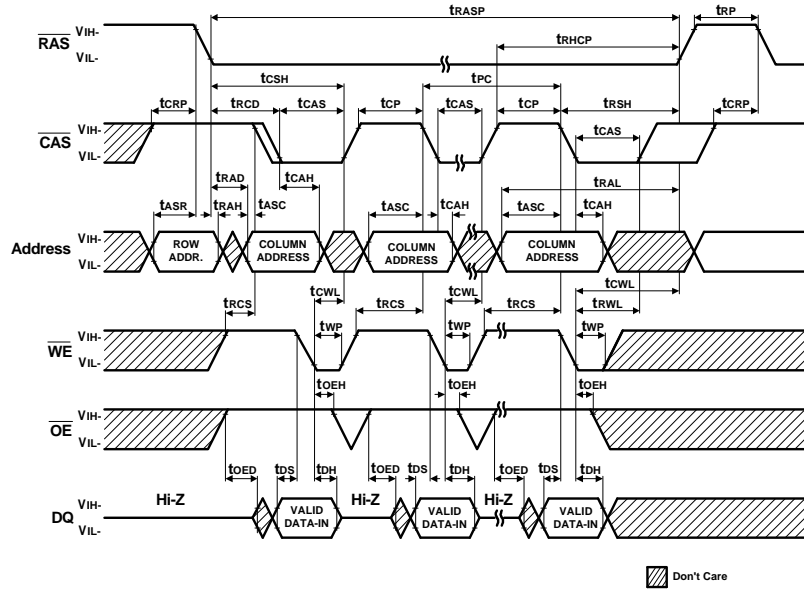
EDO Page Read Cycle



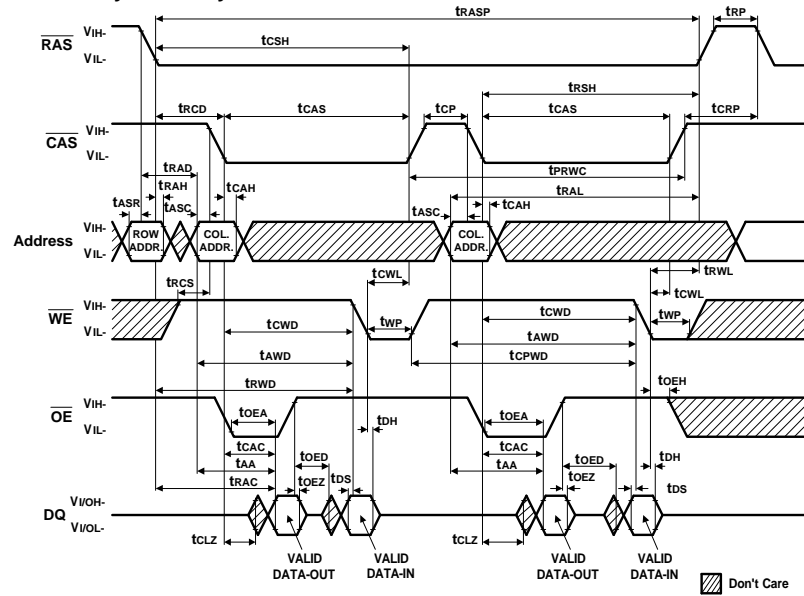
EDO Page Write Cycle NOTE : D_{out} = Open



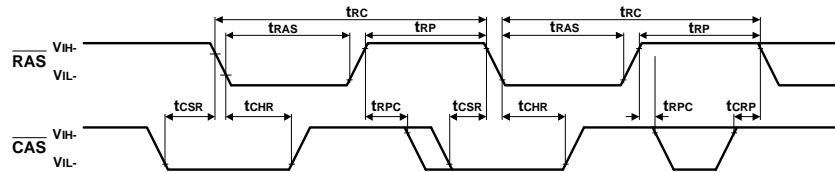
EDO Page Mode Late Write Cycle



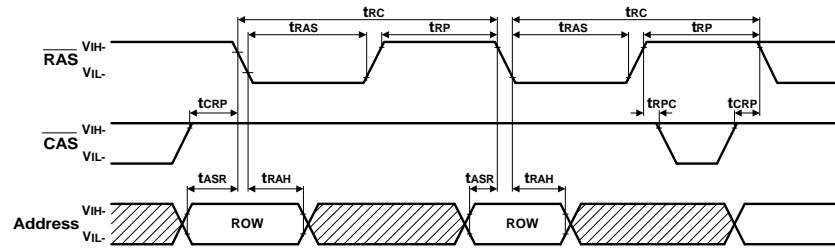
EDO Page Read - Modify - Write Cycle



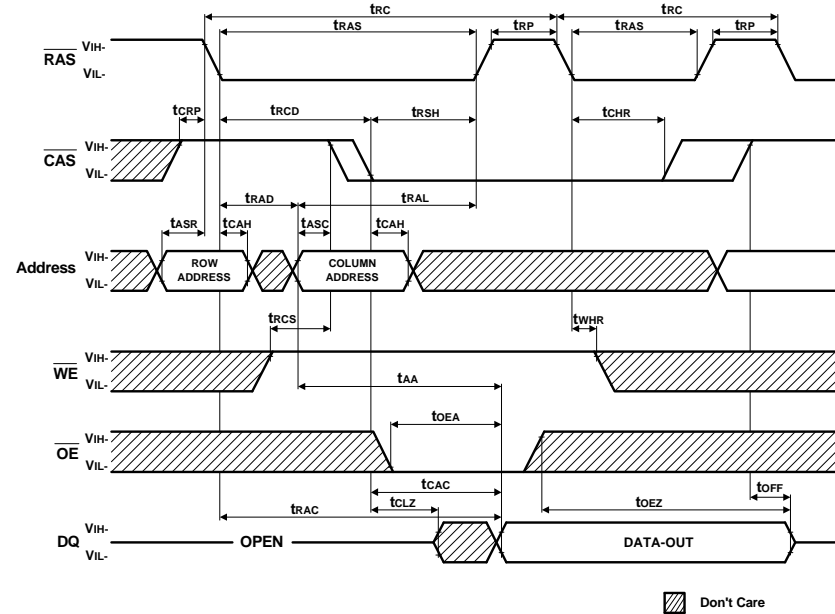
CAS Before RAS Refresh Cycle



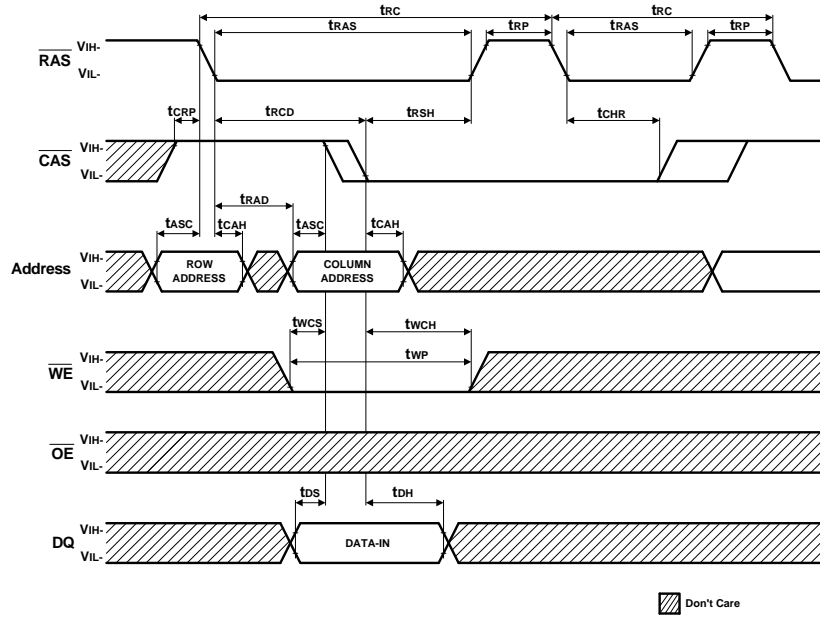
RAS -Only Refresh Cycle



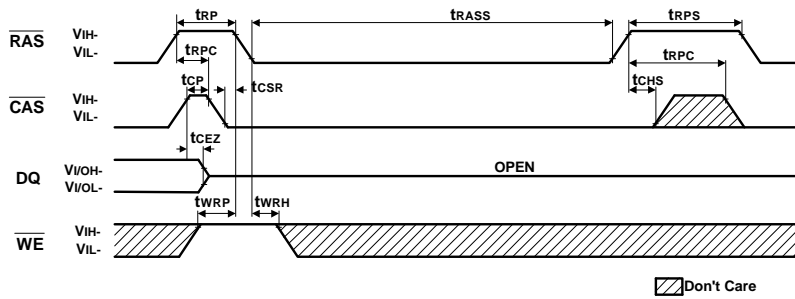
Hidden Refresh Cycle (Read)



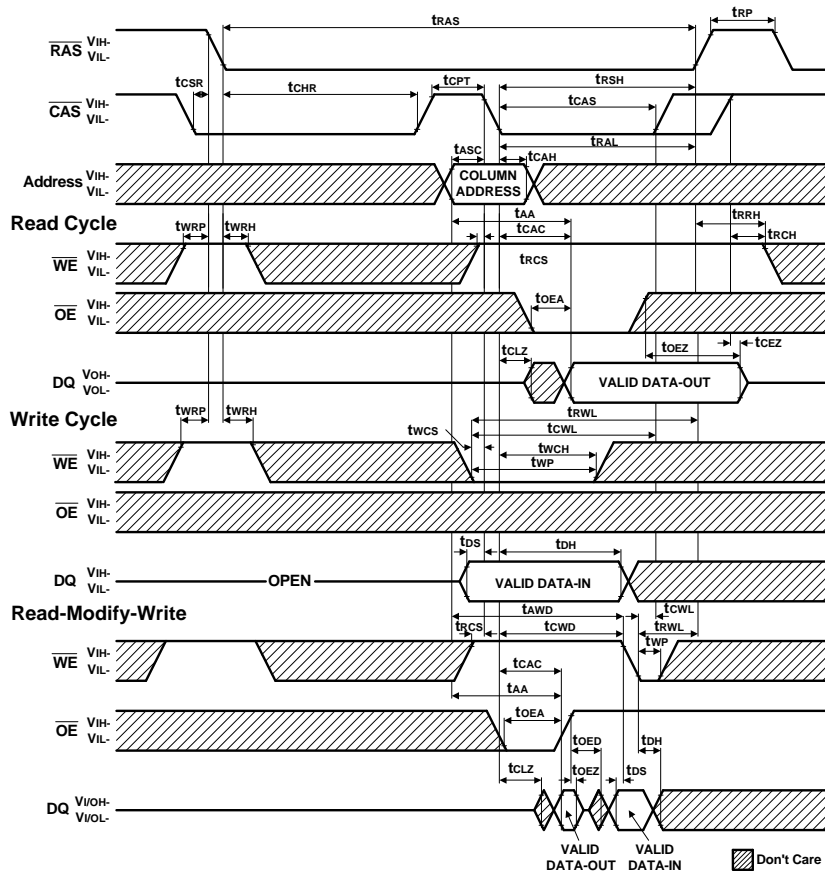
Hidden Refresh Cycle (Write) NOTE : D_{OUT} =Open



CAS-Before-RAS Self Refresh Cycle



CAS - Before RAS Refresh Counter Test Cycle



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Ordering Information

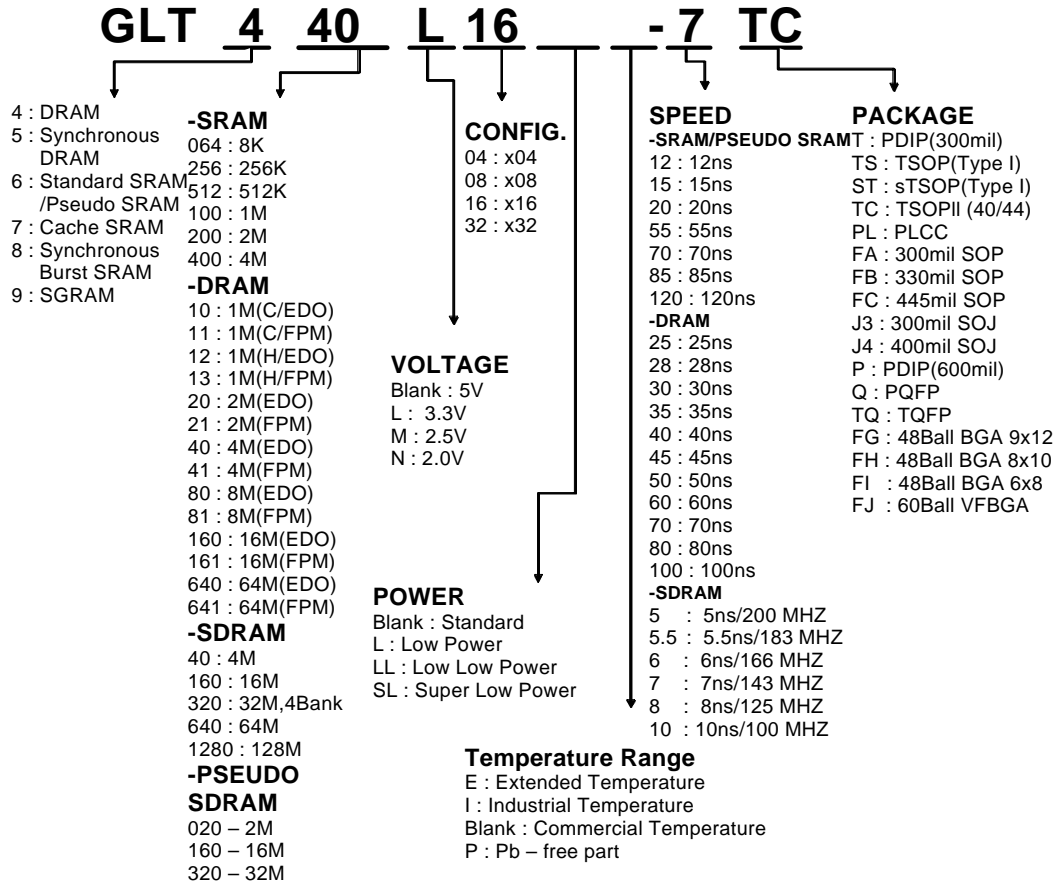
Part Number	SPEED	POWER	FEATURE	TEMPERATURE	PACKAGE
GLT440L16-35J4	35ns	Normal	EDO	Commercial	40L 400mil SOJ
GLT440L16-40J4	40ns	Normal	EDO	Commercial	40L 400mil SOJ
GLT440L16-50J4	50ns	Normal	EDO	Commercial	40L 400mil SOJ
GLT440L16-60J4	60ns	Normal	EDO	Commercial	40L 400mil SOJ
GLT440L16S-35J4	35ns	Self Refresh	EDO	Commercial	40L 400mil SOJ
GLT440L16S-40J4	40ns	Self Refresh	EDO	Commercial	40L 400mil SOJ
GLT440L16S-50J4	50ns	Self Refresh	EDO	Commercial	40L 400mil SOJ
GLT440L16S-60J4	60ns	Self Refresh	EDO	Commercial	40L 400mil SOJ
GLT440L16P-35J4	35ns	Normal	EDO	Commercial	40L 400mil SOJ
GLT440L16P-40J4	40ns	Normal	EDO	Commercial	40L 400mil SOJ
GLT440L16P-50J4	50ns	Normal	EDO	Commercial	40L 400mil SOJ
GLT440L16P-60J4	60ns	Normal	EDO	Commercial	40L 400mil SOJ
GLT440L16-35TC	35ns	Normal	EDO	Commercial	44L 400mil TSOPII
GLT440L16-40TC	40ns	Normal	EDO	Commercial	44L 400mil TSOPII
GLT440L16-50TC	50ns	Normal	EDO	Commercial	44L 400mil TSOPII
GLT440L16-60TC	60ns	Normal	EDO	Commercial	44L 400mil TSOPII
GLT440L16S-35TC	35ns	Self Refresh	EDO	Commercial	44L 400mil TSOPII
GLT440L16S-40TC	40ns	Self Refresh	EDO	Commercial	44L 400mil TSOPII
GLT440L16S-50TC	50ns	Self Refresh	EDO	Commercial	44L 400mil TSOPII
GLT440L16S-60TC	60ns	Self Refresh	EDO	Commercial	44L 400mil TSOPII
GLT440L16P-35TC	35ns	Normal	EDO	Commercial	44L 400mil TSOPII
GLT440L16P-40TC	40ns	Normal	EDO	Commercial	44L 400mil TSOPII
GLT440L16P-50TC	50ns	Normal	EDO	Commercial	44L 400mil TSOPII
GLT440L16P-60TC	60ns	Normal	EDO	Commercial	44L 400mil TSOPII

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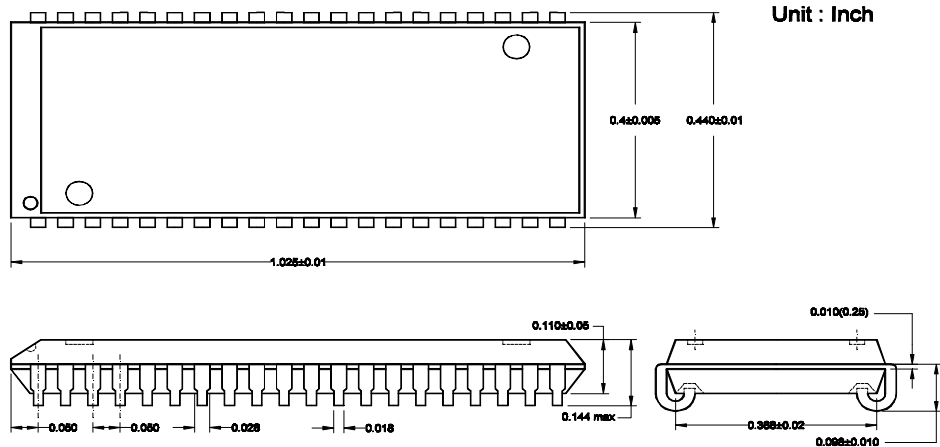
TEL : 886-2-27968078

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Parts Numbers (Top Mark) Definition for DRAM :


Package Information

400 mil 40 pin Small Outline J-form Package (SOJ)



40/44 Lead Thin Small Outline Package TSOP(Type II)

