

## Features :

- \* 4,194,304 words by 4 bits organization.
- \* Fast access time and cycle time
- \* Low power dissipation.
- \* Read-Modify-Write,  $\overline{\text{RAS}}$ -Only Refresh,  $\overline{\text{CAS}}$ -Before- $\overline{\text{RAS}}$  Refresh, Hidden Refresh.
- \* 2,048 refresh cycles per 32ms.
- \* Available in 300 mil 26(24) SOJ and TSOPII.
- \*  $3.3\text{V} \pm 0.3\text{V}$  Vcc Power Supply voltage.
- \* All inputs and Outputs are LVTTTL compatible.
- \* Extended Data-Out (EDO) Page access cycle.
- \* Self-refresh Capability. (S-Version).

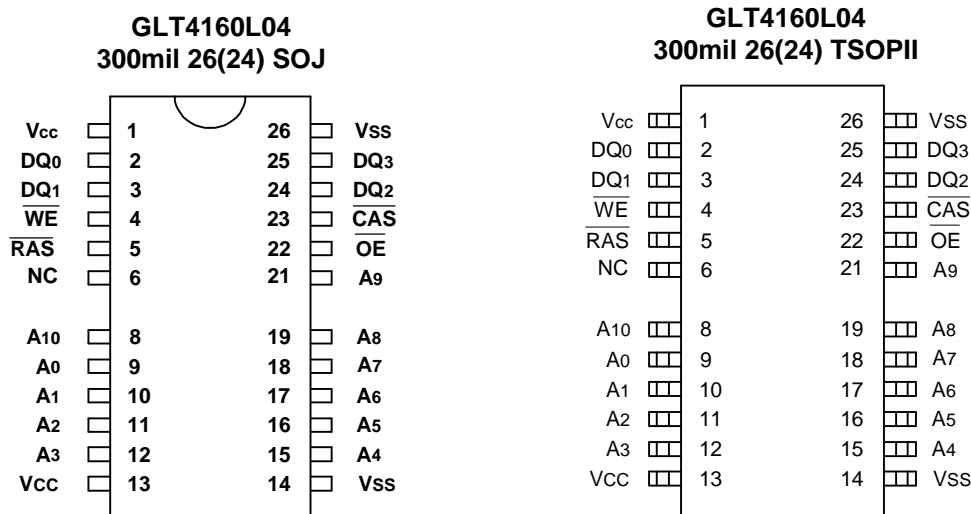
## Description :

The GLT4160L04 is a high-performance CMOS dynamic random access memory containing 16,777,216 bits organized in a x4 configuration. The GLT4160L04 offers page cycle access with Extended Data Output. The GLT4160L04 has 11 row- and 11 column-addresses, and accepts 2048-cycle refresh in 32 ms.

The GLT4160L04 provides EDO PAGE MODE operation which allows for fast data access within a row-address defined boundary, up to 2048 x 4 bits with cycle times as short as 18ns.

HIGH PERFORMANCE	40	45	50	60	70
Max. $\overline{\text{RAS}}$ Access Time, ( $t_{\text{RAC}}$ )	40 ns	45 ns	50 ns	60 ns	70 ns
Max. Column Address Access Time, ( $t_{\text{AA}}$ )	20 ns	22 ns	25 ns	30 ns	35 ns
Min. Extended Data Out Page Mode Cycle Time, ( $t_{\text{PC}}$ )	18 ns	18 ns	20 ns	25 ns	30 ns
Min. Read/Write Cycle Time, ( $t_{\text{RC}}$ )	70 ns	80 ns	84 ns	104 ns	124 ns
Max. $\overline{\text{CAS}}$ Access Time ( $t_{\text{CAC}}$ )	12 ns	12 ns	13 ns	15 ns	20 ns

## Pin Configuration :



## Pin Descriptions:

Name	Function
A <sub>0</sub> - A <sub>10</sub>	Address Inputs
RAS	Row Address Strobe
CAS	Column Address Strobe
WE	Write Enable
OE	Output Enable
DQ <sub>0</sub> - DQ <sub>3</sub>	Data Inputs / Outputs
V <sub>CC</sub>	+3.3V Power Supply
V <sub>SS</sub>	Ground
NC	No Connection

## Absolute Maximum Ratings\*

Operating Temperature,  $T_A$  (ambient)

.....0°C to

+70°C

For Extended Temperature.....-20°C to 85°C

Storage Temperature(plastic).....-55°C to +150°C

Voltage Relative to  $V_{SS}$ .....-0.5V to + 4.6V

Short Circuit Output Current.....20mA

Power Dissipation.....1.0W

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

## Capacitance\*

$T_A=25^\circ\text{C}$ ,  $V_{CC}=3.3V\pm0.3V$ ,  $V_{SS}=0V$

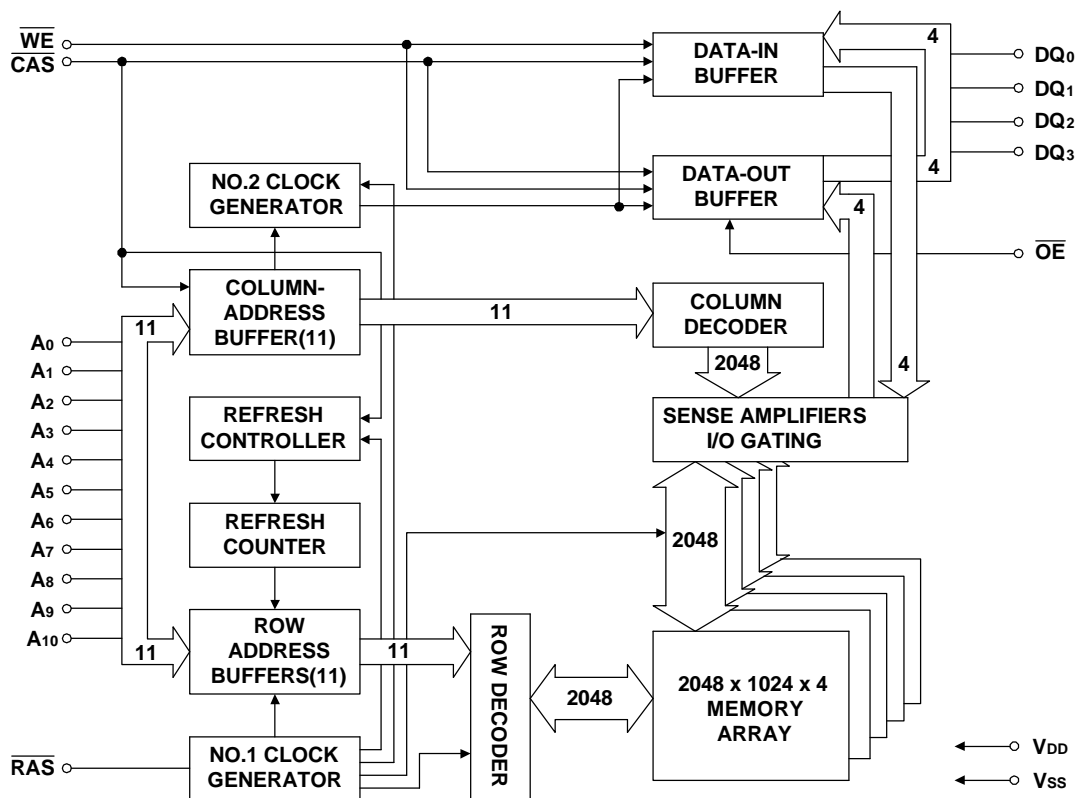
Symbol	Parameter	Max.	Unit
$C_{IN1}$	Address Input	5	pF
$C_{IN2}$	RAS, CAS, WE, OE	7	pF
$C_{OUT}$	Data Input/Output	7	pF

\*Note: Capacitance is sampled and not 100% tested

## Electrical Specifications

- All voltages are referenced to GND.
- After power up, wait more than 200 $\mu\text{s}$  and then, execute eight  $\overline{\text{CAS}}$ -before-RAS or RAS-only refresh cycles as dummy cycles to initialize internal circuit.

## Block Diagram :



**Truth Table:**

Function		RAS	CAS	WE	OE	ADDRESS		DATA-IN/OUT
						t <sub>R</sub>	t <sub>C</sub>	DQ1-DQ4
Standby		H	H→X	X	X	X	X	High-Z
READ		L	L	H	L	ROW	COL	Data-Out
EARLY WRITE		L	L	L	X	ROW	COL	Data-In
READ WRITE		L	L	H→L	L→H	ROW	COL	Data-Out,Data-In
EDO-PAGE-MODE READ	1st Cycle	L	H→L	H	L	ROW	COL	Data-Out
	2nd cycle	L	H→L	H	L	n/a	COL	Data-Out
EDO-PAGE-MODE EARLY-WRITE	1st Cycle	L	H→L	L	X	ROW	COL	Data-In
	2nd cycle	L	H→L	L	X	n/a	COL	Data-In
EDO-PAGE-MODE READ-WRITE	1st Cycle	L	H→L	H→L	L→H	ROW	COL	Data-Out,Data-In
	2nd cycle	L	H→L	H→L	L→H	n/a	COL	Data-Out,Data-In
RAS -ONLY REFRESH		L	H	X	X	ROW	n/a	High-Z
HIDDEN REFRESH	READ	L→H→L	L	H	L	ROW	COL	Data-Out
	WRITE	L→H→L	L	L	X	ROW	COL	Data-In
CBR REFRESH		H→L	L	H	X	X	X	High-Z
SELF REFRESH		H→L	L	H	X	X	X	High-Z

## DC and Operating Characteristics (1-2)

$T_A = 0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ ,  $-20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$   $V_{CC}=3.3\text{V}\pm 0.3\text{V}$ ,  $V_{SS}=0\text{V}$ , unless otherwise specified.

Sym.	Parameter	Test Conditions	Access Time	Min.	Typ	Max.	Unit	Notes
$I_{LI}$	Input Leakage Current (any input pin)	$0\text{V} \leq V_{IN} \leq V_{CC}+0.3\text{V}$ (All other pins not under test=0V)		-5		+5	$\mu\text{A}$	
$I_{LO}$	Output Leakage Current (for High-Z State)	$0\text{V} \leq V_{out} \leq V_{CC}$ Output is disabled (Hiz)		-5		+5	$\mu\text{A}$	
$I_{CC1}$	Operating Current, Random READ/WRITE	$t_{RC} = t_{RC}(\text{min.})$	$t_{RAC} = 40\text{ns}$ $t_{RAC} = 45\text{ns}$ $t_{RAC} = 50\text{ns}$ $t_{RAC} = 60\text{ns}$ $t_{RAC} = 70\text{ns}$			130 120 80 70	mA	1,2
$I_{CC2}$	Standby Current (TTL)	$\overline{\text{RAS}}, \overline{\text{CAS}}$ at $V_{IH}$ other inputs $\geq V_{SS}$				1	mA	
$I_{CC3}$	Refresh Current, $\overline{\text{RAS}}$ -Only	$\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}}$ at $V_{IH}$ $t_{RC} = t_{RC}(\text{min.})$	$t_{RAC} = 40\text{ns}$ $t_{RAC} = 45\text{ns}$ $t_{RAC} = 50\text{ns}$ $t_{RAC} = 60\text{ns}$ $t_{RAC} = 70\text{ns}$			130 120 80 70	mA	2
$I_{CC4}$	Operating Current, EDO Page Mode	$\overline{\text{RAS}}$ at $V_{IL}$ , $\overline{\text{CAS}}$ address cycling: $t_{PC}=t_{PC}(\text{min.})$	$t_{RAC} = 40\text{ns}$ $t_{RAC} = 45\text{ns}$ $t_{RAC} = 50\text{ns}$ $t_{RAC} = 60\text{ns}$ $t_{RAC} = 70\text{ns}$			130 120 80 70	mA	1,2
$I_{CC5}$	Refresh Current, $\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$	$\overline{\text{RAS}}, \overline{\text{CAS}}$ address cycling: $t_{RC}=t_{RC}(\text{min.})$	$t_{RAC} = 40\text{ns}$ $t_{RAC} = 45\text{ns}$ $t_{RAC} = 50\text{ns}$ $t_{RAC} = 60\text{ns}$ $t_{RAC} = 70\text{ns}$			130 120 80 70	mA	2
$I_{CC6}$	Standby Current, (CMOS)	$\overline{\text{RAS}} \geq V_{CC}-0.2\text{V}$ , $\overline{\text{CAS}} \geq V_{CC}-0.2\text{V}$ , All other inputs $V_{SS}$				300	$\mu\text{A}$	1,5
$I_{CC7}$	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 $0.2\text{V}$ $DQ_0 \sim DQ_3 = V_{CC}-0.2\text{V}, 0.2\text{V}$ or Open				300	$\mu\text{A}$	
$V_{IL}$	Input Low Voltage			-0.3		+0.8	V	3
$V_{IH}$	Input High Voltage			2.0		$V_{CC}+0.3$	V	4
$V_{OL}$	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  $-1\text{V}$  for a period not to exceed 15ns. All AC parameters are measured with  $V_{IL}(\text{min.}) \geq V_{SS}$  and  $V_{IH}(\text{max.}) \leq V_{CC}$ .
- Specified  $V_{IH}(\text{max.})$  is steady state operation. During transitions  $V_{IH}(\text{max.})$  may overshoot to  $V_{CC}+1\text{V}$  for a period not to exceed 15ns. All AC parameters are measured with  $V_{IL}(\text{min.}) \geq V_{SS}$  and  $V_{IH}(\text{max.}) \leq V_{CC}$ .
- S-Version.

### AC Characteristics

$T_A = 0^\circ\text{C to } 70^\circ\text{C}$ ,  $-20^\circ\text{C to } 85^\circ\text{C}$   $V_{CC} = 3.3 \text{ V} \pm 0.3\text{V}$ ,  $V_{IH}/V_{IL} = 3/0 \text{ V}$ ,  $V_{OH}/V_{OL} = 2/0.8\text{V}$

An initial pause of 200  $\mu\text{s}$  and 8 CAS-before-RAS or RAS-only refresh cycles are required after power-up.

Parameter	Symbol	40		45		50		60		70		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Read or Write Cycle Time	$t_{RC}$	70		84		84		104		124		ns	
Read Modify Write Cycle Time	$t_{RWC}$	91		116		116		140		170		ns	
RAS Precharge Time	$t_{RP}$	25		30		30		40		50		ns	
RAS Pulse Width	$t_{RAS}$	40	10K	50	10k	50	10k	60	10k	70	10k	ns	
Access Time from RAS	$t_{RAC}$		40		50		50		60		70	ns	1,2,3
Access Time from CAS	$t_{CAC}$		12		13		13		15		20	ns	1,5,7
Access Time from Column Address	$t_{AA}$		20		25		25		30		35	ns	1,5,6
CAS to Output Low-Z	$t_{CLZ}$	3		3		3		3		3		ns	
CAS to Output High-Z	$t_{CEZ}$	3	8	3	13	3	13	3	15	3	20	ns	
RAS Hold Time	$t_{RSH}$	12		13		13		15		20		ns	
CAS Hold Time	$t_{CSH}$	34		38		38		45		50		ns	
CAS Pulse Width	$t_{CAS}$	7	10k	8	10k	8	10k	10	10k	15	10k	ns	
RAS to CAS Delay Time	$t_{RCD}$	18	28	20	37	20	37	20	45	20	50	ns	
RAS to Column Address Delay Time	$t_{RAD}$	13	20	15	25	15	25	15	30	15	35	ns	7
CAS to RAS Precharge Time	$t_{CRP}$	5		5		5		5		5		ns	
Row Address Set-Up Time	$t_{ASR}$	0		0		0		0		0		ns	
Row Address Hold Time	$t_{RAH}$	8		10		10		10		10		ns	
Column Address Set-Up Time	$t_{ASC}$	0		0		0		0		0		ns	
Column Address Hold Time	$t_{CAH}$	6		8		8		10		15		ns	
Column Address to RAS Lead Time	$t_{RAL}$	20		25		25		30		35		ns	
Column Address Hold Time Referenced to RAS	$t_{AR}$	34		40		40		45		50		ns	
Read Command Set-Up Time	$t_{RCS}$	0		0		0		0		0		ns	
Read Command Hold Time Referenced to CAS	$t_{RCH}$	0		0		0		0		0		ns	4
Read Command Hold Time Referenced to RAS	$t_{RRH}$	0		0		0		0		0		ns	4
Write Command Set-Up Time	$t_{WCS}$	0		0		0		0		0		ns	8,9
Write Command Hold Time	$t_{WCH}$	6		10		10		10		15		ns	
Write Command Pulse Width	$t_{WVP}$	6		10		10		10		15		ns	
Write Command to RAS Lead Time	$t_{RWL}$	12		13		13		15		30		ns	
Write Command to CAS Lead Time	$t_{CWL}$	8		8		8		10		15		ns	

## AC Characteristics

Parameter	Symbol	40		45		50		60		70		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Data Set-Up Time	$t_{DS}$	0				0		0		0		ns	10
Data Hold Time	$t_{DH}$	7				8		10		15		ns	10
Data Hold Time Referenced to $\overline{RAS}$	$t_{DHR}$	36				40		45		50		ns	
$\overline{RAS}$ to $\overline{WE}$ Delay Time	$t_{RWD}$	54				67		79		94		ns	
$\overline{CAS}$ to $\overline{WE}$ Delay Time	$t_{CWD}$	24				30		34		44		ns	
Column Address to $\overline{WE}$ Delay Time	$t_{AWD}$	32				42		49		59		ns	
$\overline{CAS}$ Precharge to $\overline{WE}$ Delay	$t_{CPWD}$	47				47		54		64		ns	
$\overline{RAS}$ to $\overline{CAS}$ Precharge Time	$t_{RPC}$	5				5		5		5		ns	
$\overline{CAS}$ precharge time ( $\overline{CAS}$ Before $\overline{RAS}$ counter test cycle)	$t_{CPT}$	20				20		20		25		ns	
Access Time from $\overline{CAS}$ Precharge	$t_{CPA}$		22				28		35		40	ns	
EDO Page Mode Cycle Time	$t_{PC}$	18				20		25		30		ns	
EDO Page Mode Read-Modify-Write Cycle Time	$t_{PRWC}$	50				47		56		71		ns	
$\overline{CAS}$ Precharge Time (EDO Page Mode)	$t_{CP}$	6				8		10		10		ns	
$\overline{RAS}$ Pulse Width (EDO Page Mode Only)	$t_{RASP}$	40	100k			50	100k	60	100k	70	100k	ns	
$\overline{RAS}$ Hold Time from $\overline{CAS}$ precharge	$t_{RHCP}$	30				30		35		40		ns	
Access Time from $\overline{OE}$	$t_{OEA}$		12				13		15		20	ns	
$\overline{OE}$ to Data Delay Time	$t_{OED}$	8				13		15		20		ns	
$\overline{OE}$ to Output Low-Z	$t_{OLZ}$	3				3		3		3		ns	
$\overline{OE}$ to Output High-Z	$t_{OEZ}$	3	8			3	13	3	15	3	20	ns	
$\overline{WE}$ to Data Delay	$t_{WED}$	15				15		15		20		ns	
$\overline{OE}$ Command Hold Time	$t_{OEH}$	7				13		15		20		ns	
Data Output Hold after $\overline{CAS}$ low	$t_{DOH}$	3				5		5		5		ns	
$\overline{RAS}$ to Output High-Z	$t_{REZ}$	3	8			3	13	3	15	3	20	ns	
$\overline{WE}$ to Output High-Z	$t_{WEZ}$	3	10			3	13	3	15	3	20	ns	
$\overline{OE}$ to $\overline{CAS}$ Hold Time	$t_{OCH}$	5				5		5		5		ns	
$\overline{CAS}$ Hold Time to $\overline{OE}$	$t_{CHO}$	5				5		5		5		ns	
$\overline{OE}$ Precharge Time	$t_{OEP}$	5				5		5		5		ns	
$\overline{WE}$ Pulse width (EDO mixed read write cycle)	$t_{WPE}$	5				5		5		5		ns	
$\overline{CAS}$ Set-Up Time for $\overline{CAS}$ -before- $\overline{RAS}$ Cycle	$t_{CSR}$	5				5		5		5		ns	

Parameter	Symbol	40		45		50		60		70		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
CAS Hold Time for CAS-before-RAS Cycle	$t_{CHR}$	8				10		10		15		ns	
WE to RAS precharge time ( CAS Before RAS refresh )	$t_{WRP}$	10				10		10		10		ns	
WE to RAS hold time ( CAS Before RAS refresh )	$t_{WRH}$	10				10		10		10		ns	
Transition Time	$t_T$	2	50			2	50	2	50	2	50	ns	11
Refresh Period (2,048 cycles)	$t_{REF}$		32				32		32		32	ms	
Refresh Period (S-Version)	$t_{REF}$		128				128		128		128	ms	
RAS Pulse Width ( CAS Before RAS Self refresh )	$t_{RASS}$	100				100		100		100		$\mu$ s	
RAS precharge Time ( CAS Before RAS Self refresh )	$t_{RPS}$	70				90		110		130		ns	
CAS Hold Time ( CAS Before RAS Self refresh )	$t_{CHS}$	-50				-50		-50		-50		ns	

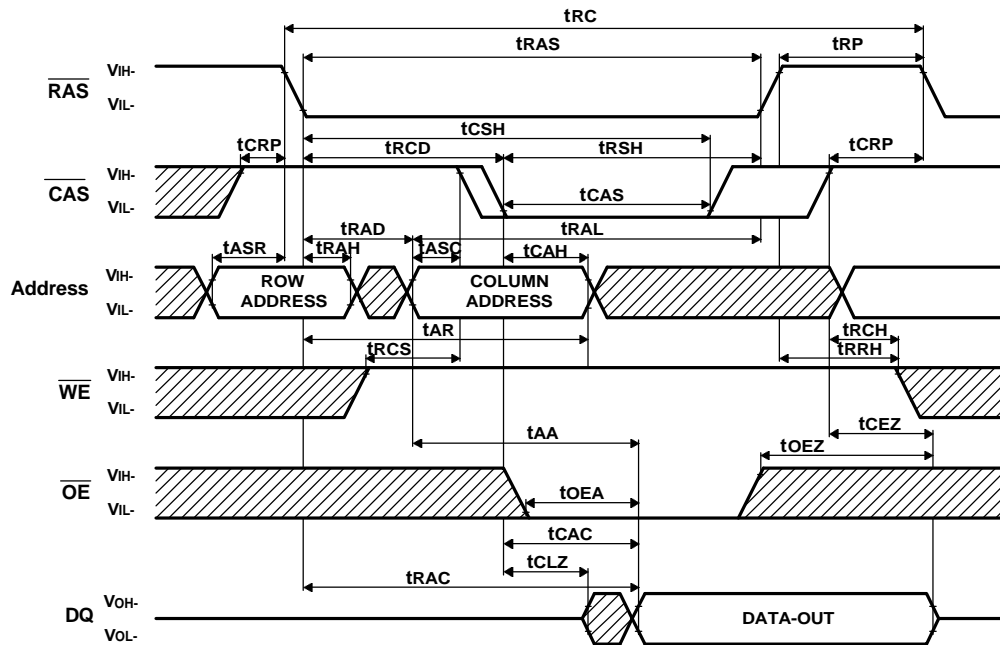


**TEST MODE CYCLE**

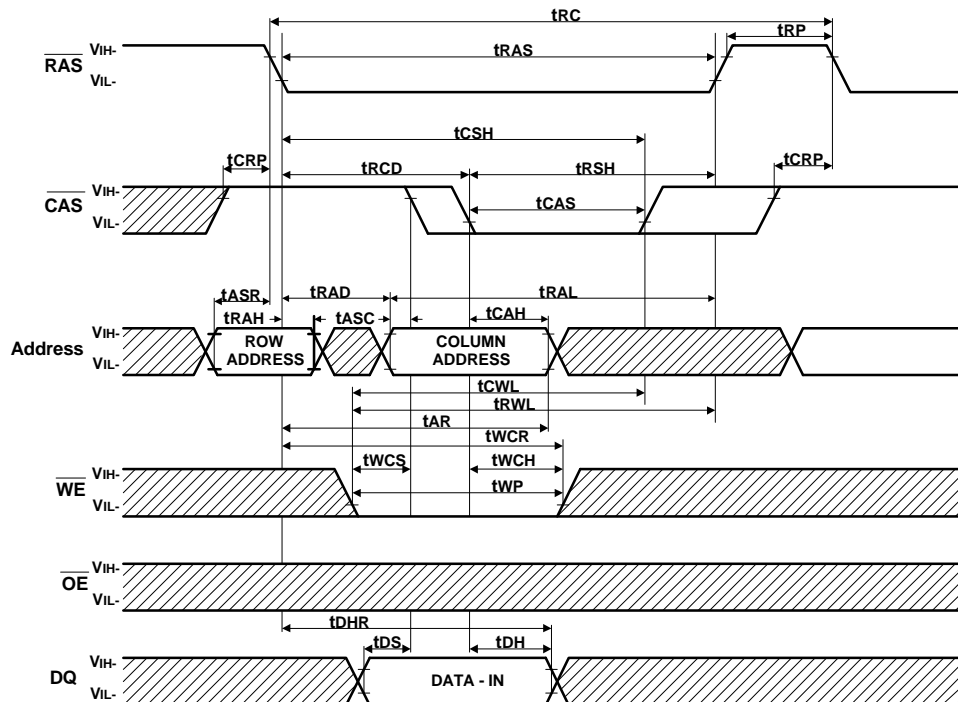
Parameter	Symbol	40		50		60		70		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Random read or write cycle time	$t_{RC}$	89		89		109		129		ns	
Read-modify-write cycle time	$t_{RWC}$	121		121		145		175		ns	
Access time from $\overline{RAS}$	$t_{RAC}$		55		55		65		75	ns	1,2,3,7
Access time from $\overline{CAS}$	$t_{CAC}$		18		18		20		25	ns	1,3,7
Access time from column address	$t_{AA}$		30		30		35		40	ns	1,2,7
$\overline{RAS}$ pulse width	$t_{RAS}$	55	10k	55	10k	65	10k	75	10k	ns	
$\overline{CAS}$ pulse width	$t_{CAS}$	13	10k	13	10k	15	10k	20	10k	ns	
$\overline{RAS}$ hold time	$t_{RSH}$	18		18		20		25		ns	
$\overline{CAS}$ hold time	$t_{CSH}$	43		43		50		55		ns	
Column address to $\overline{RAS}$ lead time	$t_{RAL}$	30		30		35		40		ns	
$\overline{CAS}$ to $\overline{WE}$ delay time	$t_{CWD}$	35		35		39		49		ns	8
$\overline{RAS}$ to $\overline{WE}$ delay time	$t_{RWD}$	72		72		84		99		ns	8
Column address to $\overline{WE}$ delay time	$t_{AWD}$	47		47		54		64		ns	8
$\overline{CAS}$ Precharge to $\overline{WE}$ delay time	$t_{CPWD}$	52		52		59		69		ns	8
EDO Page Mode cycle time	$t_{PC}$	25		25		30		35		ns	
EDO page mode read-modify-write cycle time	$t_{PRWC}$	53		53		61		76		ns	
$\overline{RAS}$ Pulse width (EDO page cycle)	$t_{RASP}$	55	100k	55	100k	65	100k	75	100k	ns	
Access time form $\overline{CAS}$ precharge	$t_{CPA}$		33		33		40		45	ns	1
$\overline{OE}$ access time	$t_{OEA}$		18		18		20		25	ns	
$\overline{OE}$ to data delay	$t_{OED}$	18		18		20		25		ns	
$\overline{OE}$ command hold time	$t_{OEH}$	18		18		20		25		ns	
Write command set-up time (Test mode in)	$t_{WTS}$	10		10		10		10		ns	
Write command hold time (Test mode in)	$t_{WTH}$	10		10		10		10		ns	

**Notes:**

1. Measure with a load equivalent to one TTL input and 100 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  $t_{CAC}$  dominant.
3. Assumes that  $t_{RAD} \leq t_{RAD}(\text{max.})$ . If  $t_{RAD}$  is greater than  $t_{RAD}(\text{max.})$ , access time will be controlled by  $t_{AA}$ .
4. Either  $t_{RRH}$  or  $t_{RCH}$  must be satisfied for a Read Cycle.
5. Access time is determined by the longest of  $t_{AA}$ ,  $t_{CAC}$  and  $t_{CPA}$ .
6. Assumes that  $t_{RAD} \geq t_{RAD}(\text{max.})$ .
7. Assumes that  $t_{RCD} \geq t_{RCD}(\text{max.})$ .
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  $\overline{\text{CAS}}$  or  $\overline{\text{WE}}$ .
11.  $t_T$  is measured between  $V_{IH}(\text{min.})$  and  $V_{IL}(\text{max.})$ . AC-measurements assume  $t_T = 2 \text{ ns}$ .

**Read CYCLE**


 Don't Care

**Early Write Cycle NOTE :  $D_{OUT} = OPEN$** 


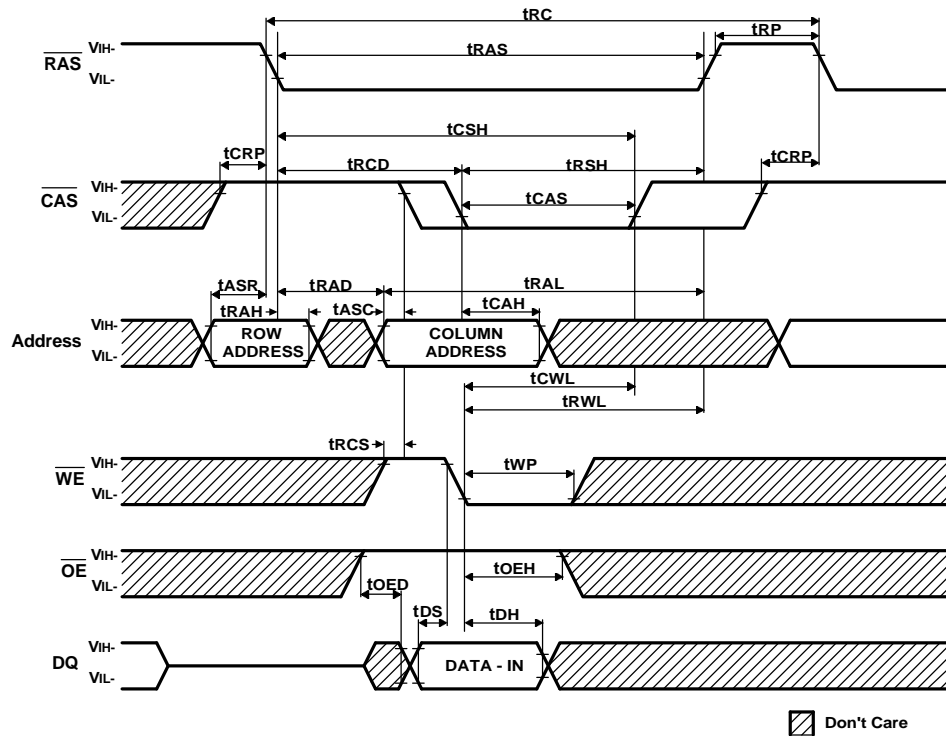
 Don't Care

**G-Link Technology Corporation, Taiwan**

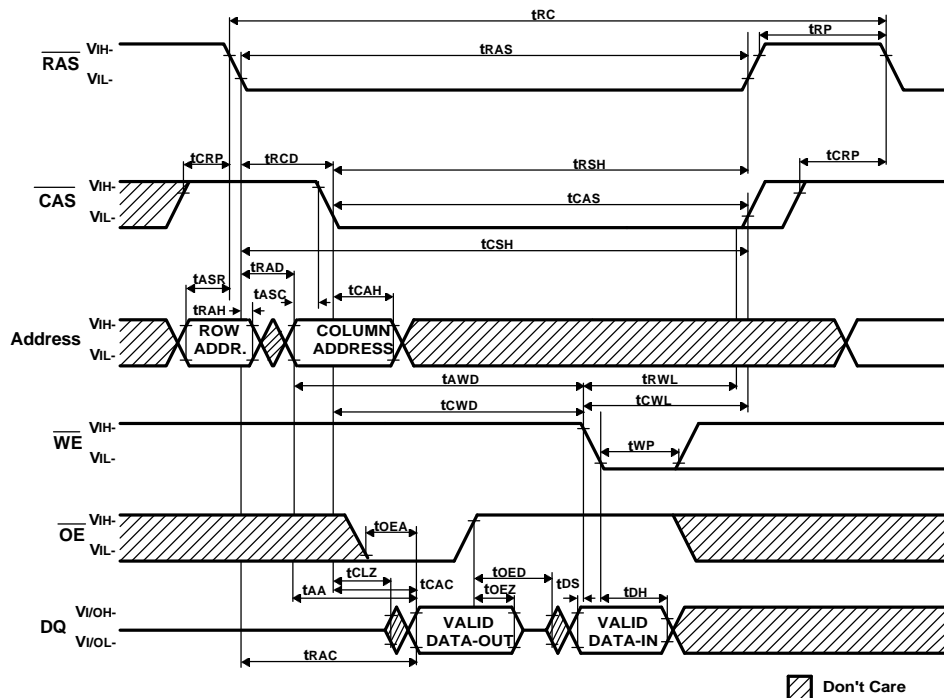
Web : [www.glink.com.tw](http://www.glink.com.tw) Email : [sales@glink.com.tw](mailto:sales@glink.com.tw)

TEL : 886-2-26599658

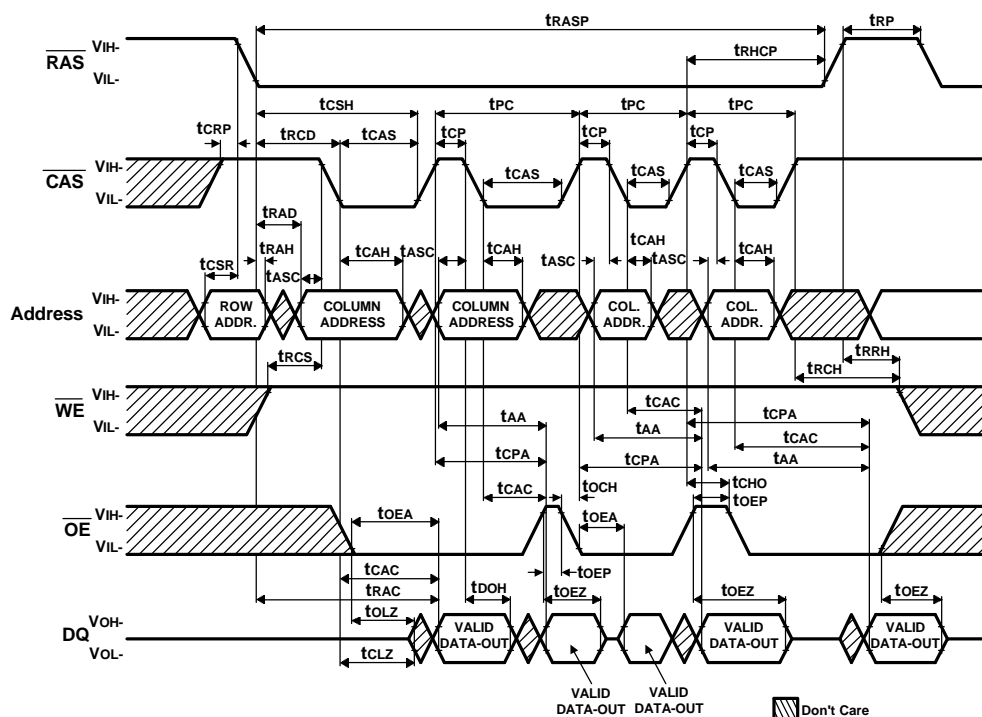
**OE Controlled Write Cycle NOTE : D<sub>OUT</sub> = OPEN**



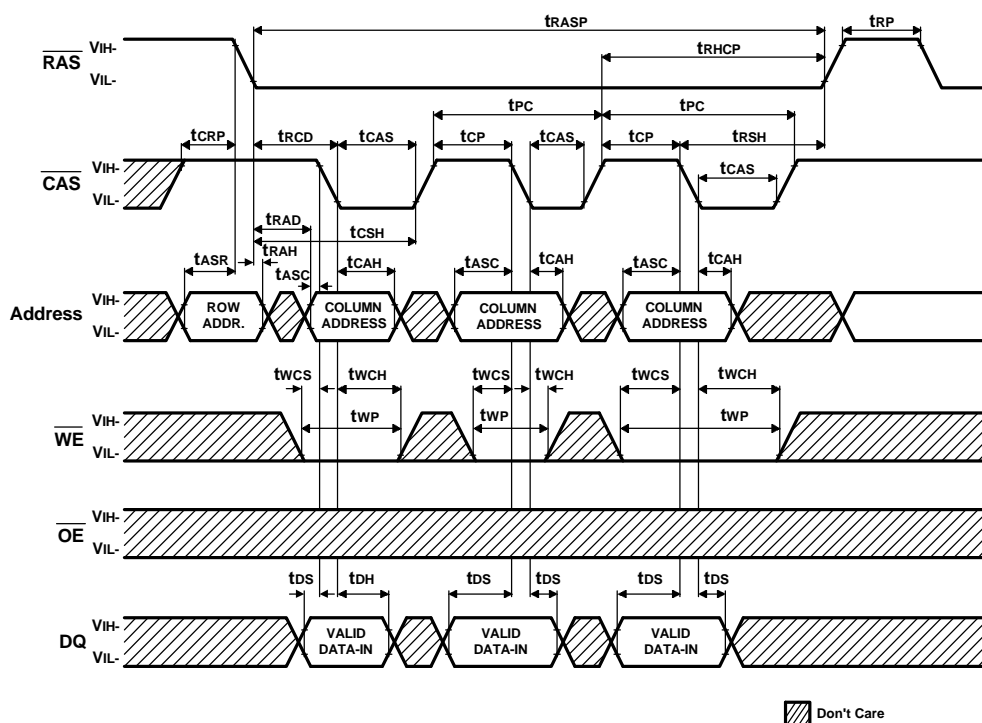
**Read - Modify - Write Cycle**



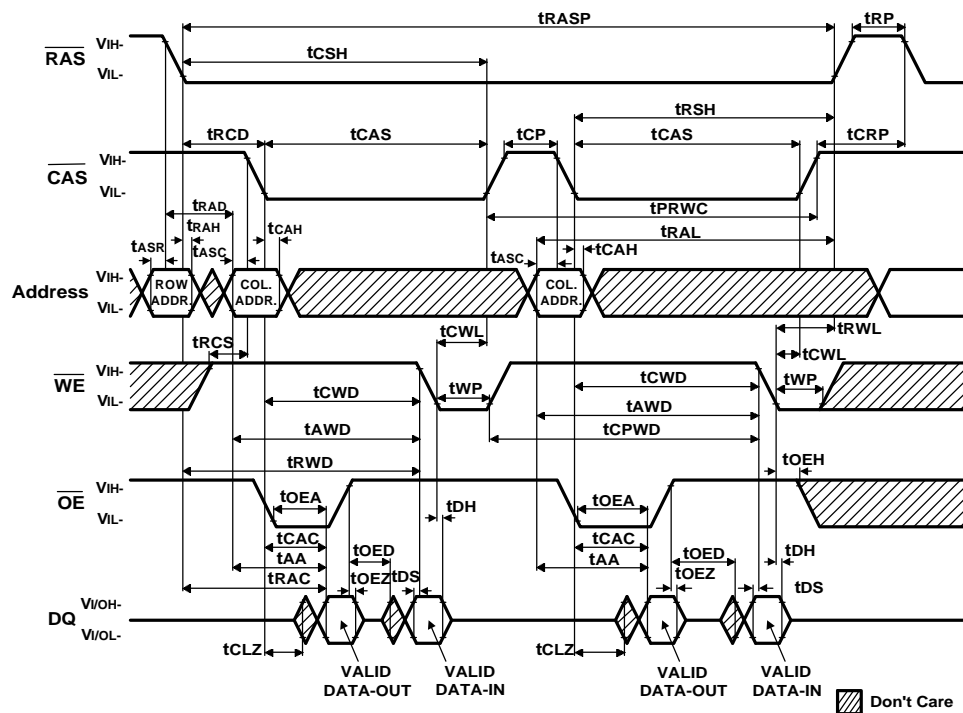
**EDO Page Mode Read Cycle NOTE : D<sub>OUT</sub> = OPEN**



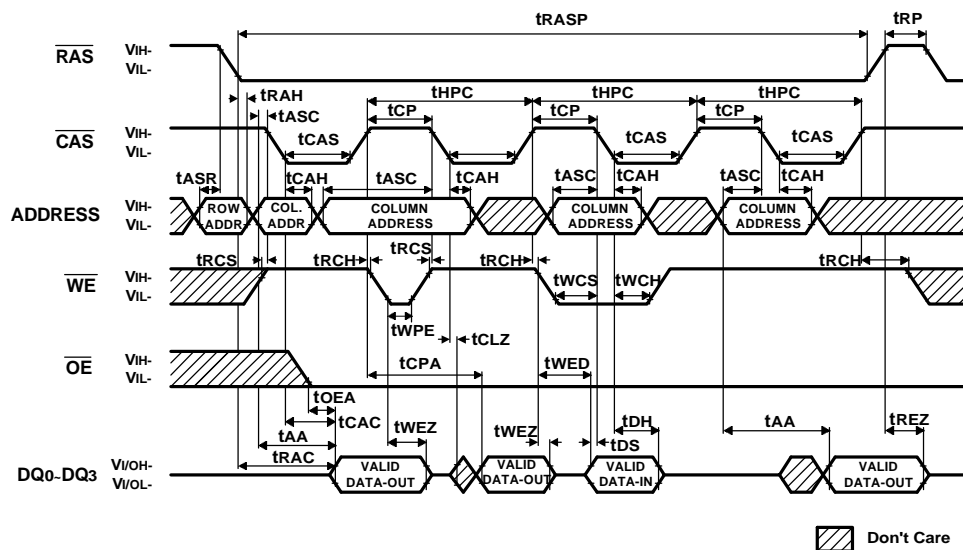
**EDO Page Mode Early Write Cycle NOTE : D<sub>OUT</sub> = OPEN**



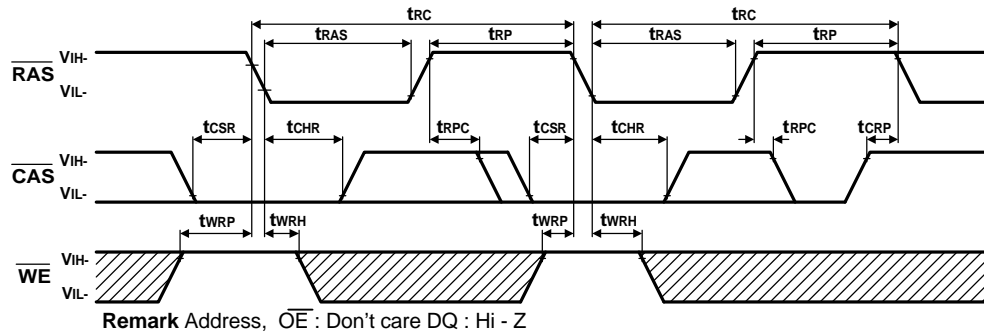
**EDO Page Mode Read - Modify - Write Cycle NOTE : D<sub>OUT</sub> = OPEN**



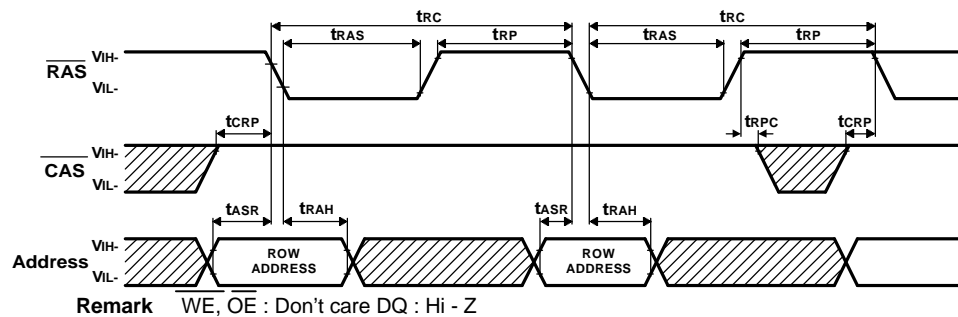
## EDO PAGE READ AND WRITE MIXED CYCLE



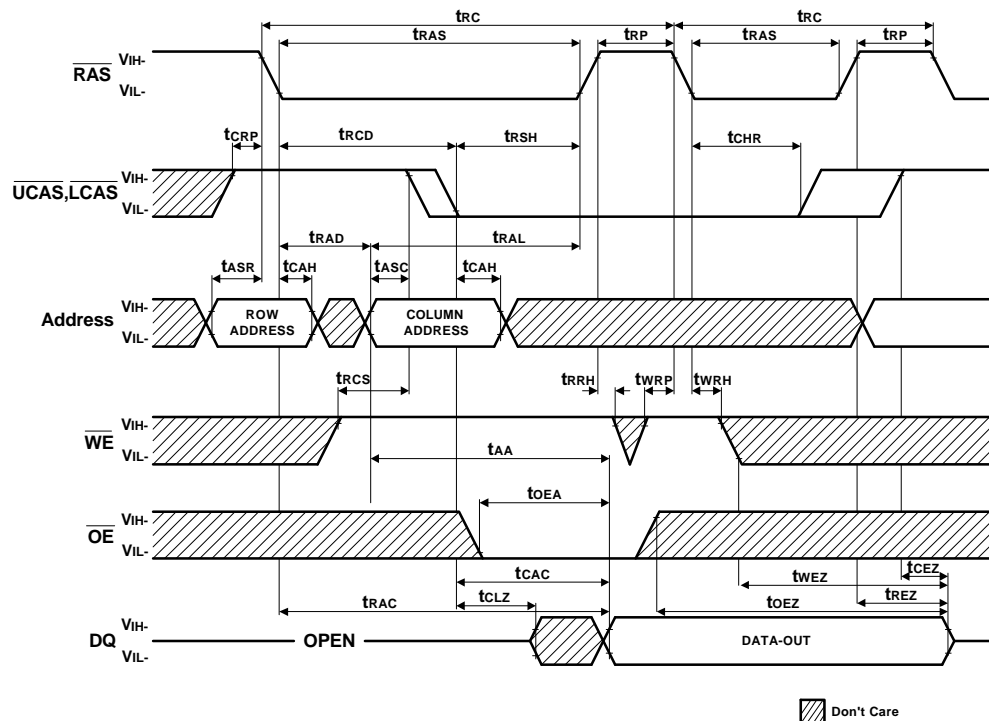
### CAS - Before - RAS Refresh Cycle



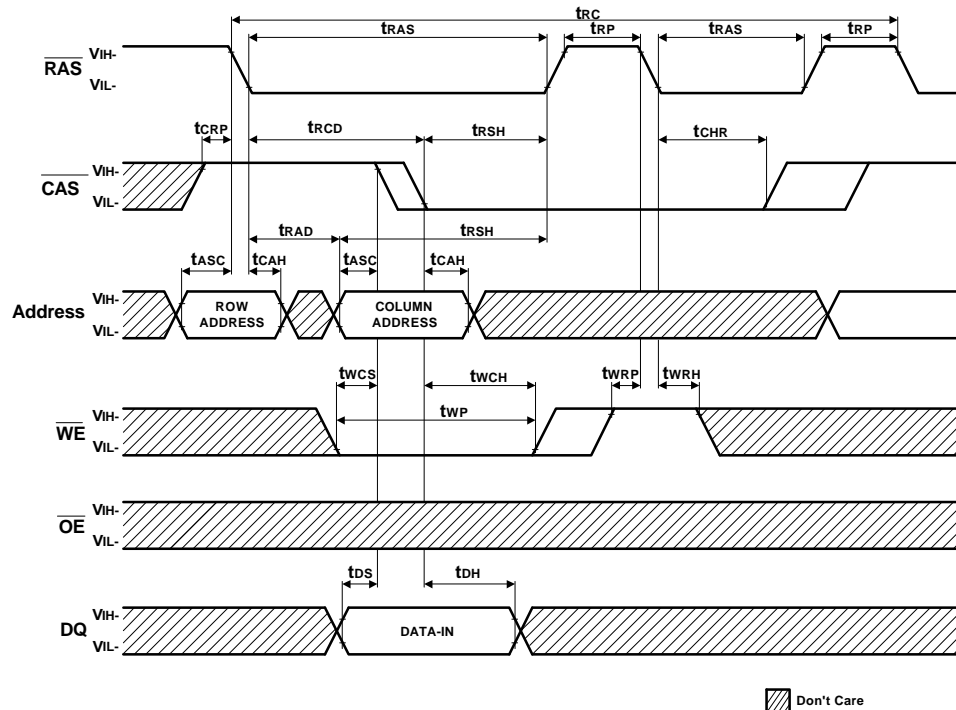
### RAS-Only Refresh Cycle



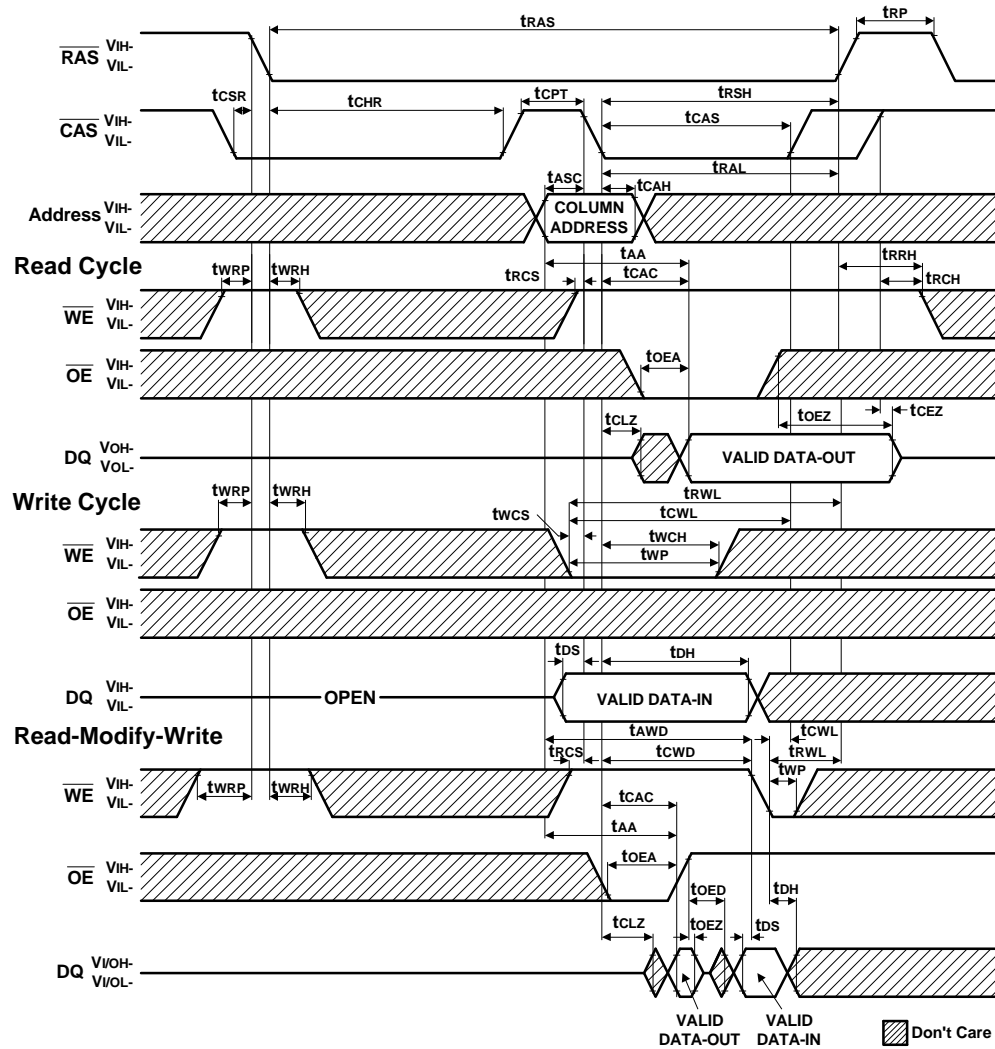
### Hidden Refresh Cycle ( Read )



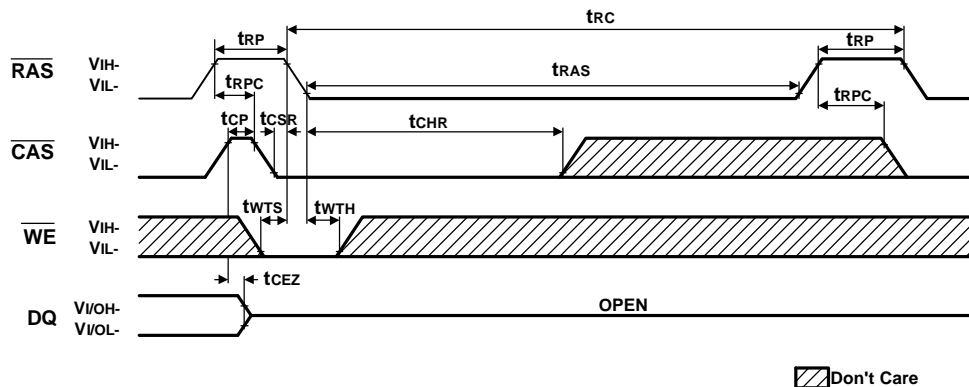
**Hidden Refresh Cycle ( Write ) NOTE : D<sub>OUT</sub> = OPEN**





**CAS-Before RAS Refresh Counter Test Cycle**


## TEST MODE IN CYCLE



## Test Mode

By using the test mode, the test time can be reduced. The reason for this is that, the memory emulates the x 16-bit organization during test mode. Don't care about the input levels of the  $\overline{\text{CAS}}$  input A0, A1 .

### (1) Setting the mode

Executing the test mode cycle ( $\overline{\text{WE}}$  ,  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh cycle ) sets the test mode.

### (2) Write / read operation

When either a "0" or a "1" is written to the input pin in test mode, this data is written to 16 bits of memory cell.

Next, when the data is read from the output pin at the same address, the cell be checked.

Output = "1" Normal write (all memory cells)  
 Output = "0" Abnormal write

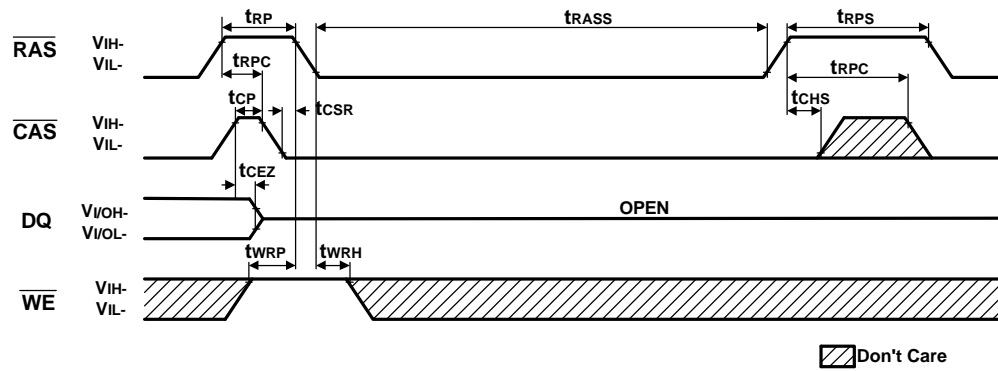
### (3) Refresh

Refresh in the test mode must be performed with the  $\overline{\text{RAS}}$  /  $\overline{\text{CAS}}$  cycle or with the  $\overline{\text{WE}}$ ,  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh cycle. The  $\overline{\text{WE}}$ ,  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh cycle use the same counter as the  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh's internal counter.

### (4) Mode Cancellation

The test mode is cancelled by executing one cycle of  $\overline{\text{RAS}}$  only refresh cycle or  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh cycle.

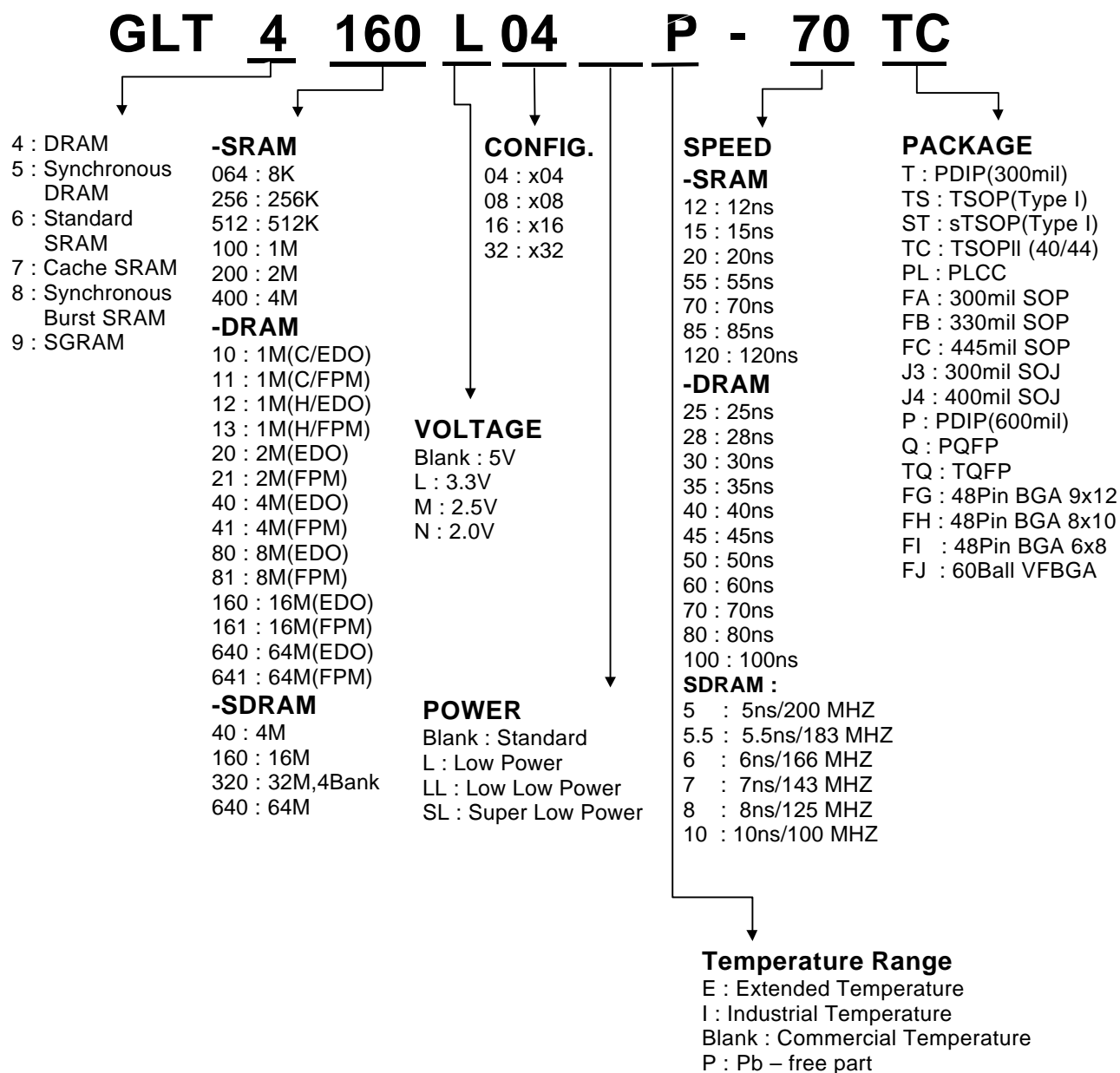
**CAS-BEFORE-RAS SELF REFRESH CYCLE**



NOTE :  $\overline{OE}$  , Address = Don't Care

## Ordering Information

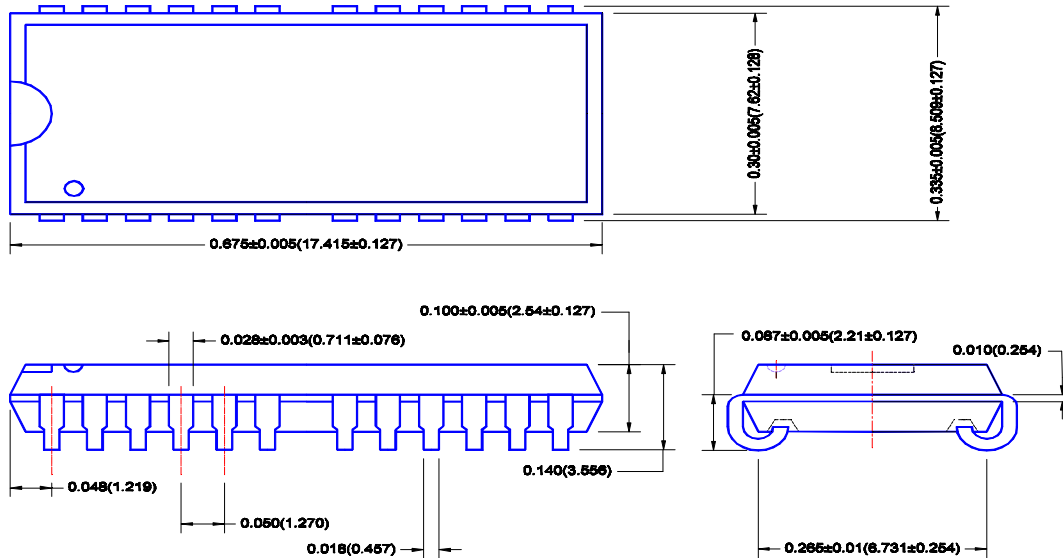
<i>Part Number</i>	<i>SPEED</i>	<i>POWER</i>	<i>FEATURE</i>	<i>TEMPERATURE</i>	<i>PACKAGE</i>
GLT4160L04-40J3	40ns	Normal	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04-50J3	50ns	Normal	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04-60J3	60ns	Normal	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04-70J3	70ns	Normal	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04E-40J3	40ns	Normal	EDO	Extended	SOJ 300mil 26(24)L
GLT4160L04E-50J3	50ns	Normal	EDO	Extended	SOJ 300mil 26(24)L
GLT4160L04E-60J3	60ns	Normal	EDO	Extended	SOJ 300mil 26(24)L
GLT4160L04E-70J3	70ns	Normal	EDO	Extended	SOJ 300mil 26(24)L
GLT4160L04S-40J3	40ns	Self Refresh	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04S-50J3	50ns	Self Refresh	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04S-60J3	60ns	Self Refresh	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04S-70J3	70ns	Self Refresh	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04SE-40J3	40ns	Self Refresh	EDO	Extended	SOJ 300mil 26(24)L
GLT4160L04SE-50J3	50ns	Self Refresh	EDO	Extended	SOJ 300mil 26(24)L
GLT4160L04SE-60J3	60ns	Self Refresh	EDO	Extended	SOJ 300mil 26(24)L
GLT4160L04SE-70J3	70ns	Self Refresh	EDO	Extended	SOJ 300mil 26(24)L
GLT4160L04P-40J3	40ns	Normal	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04P-50J3	50ns	Normal	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04P-60J3	60ns	Normal	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04P-70J3	70ns	Normal	EDO	Commercial	SOJ 300mil 26(24)L
GLT4160L04-40TC	40ns	Normal	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04-50TC	50ns	Normal	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04-60TC	60ns	Normal	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04-70TC	70ns	Normal	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04E-40TC	40ns	Normal	EDO	Extended	TSOPII 300mil 26(24)L
GLT4160L04E-50TC	50ns	Normal	EDO	Extended	TSOPII 300mil 26(24)L
GLT4160L04E-60TC	60ns	Normal	EDO	Extended	TSOPII 300mil 26(24)L
GLT4160L04E-70TC	70ns	Normal	EDO	Extended	TSOPII 300mil 26(24)L
GLT4160L04S-40TC	40ns	Self Refresh	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04S-50TC	50ns	Self Refresh	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04S-60TC	60ns	Self Refresh	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04S-70TC	70ns	Self Refresh	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04SE-40TC	40ns	Self Refresh	EDO	Extended	TSOPII 300mil 26(24)L
GLT4160L04SE-50TC	50ns	Self Refresh	EDO	Extended	TSOPII 300mil 26(24)L
GLT4160L04SE-60TC	60ns	Self Refresh	EDO	Extended	TSOPII 300mil 26(24)L
GLT4160L04SE-70TC	70ns	Self Refresh	EDO	Extended	TSOPII 300mil 26(24)L
GLT4160L04P-40TC	40ns	Normal	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04P-50TC	50ns	Normal	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04P-60TC	60ns	Normal	EDO	Commercial	TSOPII 300mil 26(24)L
GLT4160L04P-70TC	70ns	Normal	EDO	Commercial	TSOPII 300mil 26(24)L

**Parts Numbers (Top Mark) Definition :**


### Package Information

300mil 24/26 Lead Thin Small Outline Package SOJ

**Unit : Inch(mm)**



300mil 24/26 Lead Thin Small Outline Package (TSOP) TYPE II

**Unit : Inch(mm)**

