REVISION HISTORY

Revision	Description	Issue Date
Rev. 1.0	Initial Issue	Jul.25.2004
Rev. 1.1	Deleted I_{CC1} Spec. Revised **TRUTH TABLE**	Sep.21.2004
Rev. 1.2	Deleted **DATA RETENTION WAVEFORM**(2) (UB & LB controlled)	Jun.20.2005
Rev. 1.3	Revised the typo in page 1	Feb.13.2006
Rev. 1.4	Added PKG Type : 48-ball 6mm x 8mm TFBGA Revised **TEST CONDITION** of I_{SB1}/I_{DR}	Jun.13.2007
Rev. 1.5	Added I Grade Spec. Revised V_{TERM} to V_{T1} and V_{T2}	Feb.04.2008
Rev. 1.6	Added -20ns Spec.	Mar.31.2008
Rev. 1.7	Added LL Spec.	Aug.07.2008
Rev. 1.8	Revised **TEST CONDITION** of I_{SB} Revised **FEATURES** & **ORDERING INFORMATION** **Lead free and green package available** to **Green package available** Deleted T_{SOLDER} in **ABSOLUTE MAXIMUN RATINGS** Added packing type in **ORDERING INFORMATION**	Apr.17.2009
Rev. 1.9	Revised **PACKAGE OUTLINE DIMENSION** in page 11	May.06.2010
Rev. 2.0	Revised **ORDERING INFORMATION** in page 12	Aug.30.2010
Rev. 2.1	Revised **TRUTH TABLE** in page 4	Dec.14.2015
Rev. 2.2	Correct **ORDERING INFORMATION** Typo.	May.20.2016
Rev. 2.3	Revised **PIN DESCRIPTION** in page 2 Deleted -8/20ns Spec. Deleted Power Type in **ORDERING INFORMATION** Deleted **DC ELECTRICAL CHARACTERISTICS** Notes : 6. 50μA for special request. In page 5 Deleted **WRITE CYCLE** Notes : 1. WE#,CE#, LB#, UB# must be high during all address transitions. In page 9	Dec.13.2016

LY61L6416

64K X 16 BIT HIGH SPEED CMOS SRAM

FEATURES

- Fast access time : 10/12/15ns
- Low power consumption:
  Operating current : 105/95/85mA (TYP.)
  Standby current : 0.6mA (TYP.)
- Single 3.3V power supply
- All inputs and outputs TTL compatible
- Fully static operation
- Tri-state output
- Data byte control : LB# (DQ0 ~ DQ7)
  UB# (DQ8 ~ DQ15)
- Data retention voltage : 2.0V (MIN.)
- **Green package available**
- Package : 44-pin 400 mil TSOP II
  48-ball 6mm x 8mm TFBGA

GENERAL DESCRIPTION

The LY61L6416 is a 1,048,576-bit low power CMOS static random access memory organized as 65,536 words by 16 bits. It is fabricated using very high performance, high reliability CMOS technology. Its standby current is stable within the range of operating temperature.

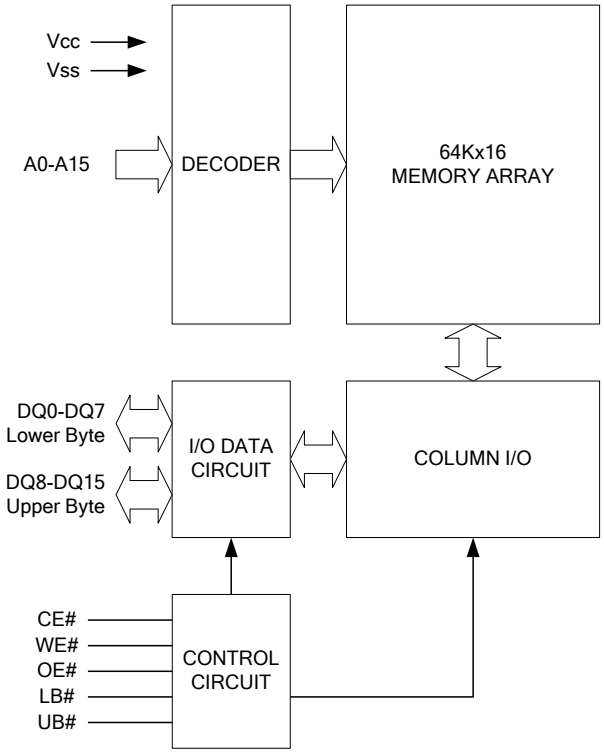
The LY61L6416 is well designed for low power application, and particularly well suited for battery back-up nonvolatile memory application.

The LY61L6416 operates from a single power supply of 3.3V and all inputs and outputs are fully TTL compatible

PRODUCT FAMILY

Product Family	Operating Temperature	V_{CC} Range	Speed	Power Dissipation	
				Standby(I_{SB1},TYP.)	Operating(I_{CC},TYP.)
LY61L6416	0 ~ 70℃	3.15 ~ 3.6V	10ns	0.6mA	105mA
LY61L6416	0 ~ 70℃	3.0 ~ 3.6V	12/15ns	0.6mA	95/85mA
LY61L6416(E)	-20 ~ 80℃	3.15 ~ 3.6V	10ns	0.6mA	105mA
LY61L6416(E)	-20 ~ 80℃	3.0 ~ 3.6V	12/15ns	0.6mA	95/85mA
LY61L6416(I)	-40 ~ 85℃	3.15 ~ 3.6V	10ns	0.6mA	105mA
LY61L6416(I)	-40 ~ 85℃	3.0 ~ 3.6V	12/15ns	0.6mA	95/85mA

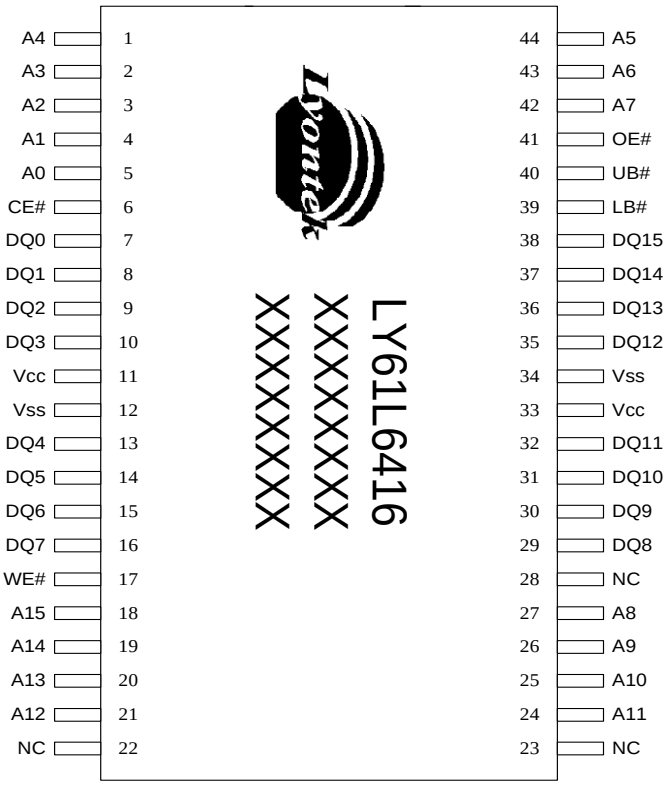
FUNCTIONAL BLOCK DIAGRAM



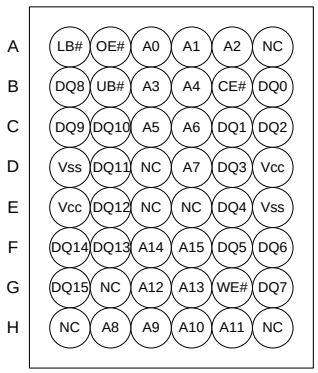
PIN DESCRIPTION

SYMBOL	DESCRIPTION
A0 - A15	Address Inputs
DQ0 - DQ15	Data Inputs/Outputs
CE#	Chip Enable Input
WE#	Write Enable Input
OE#	Output Enable Input
LB#	Lower Byte Control
UB#	Upper Byte Control
V_{CC}	Power Supply
V_{SS}	Ground
NC	No Connection

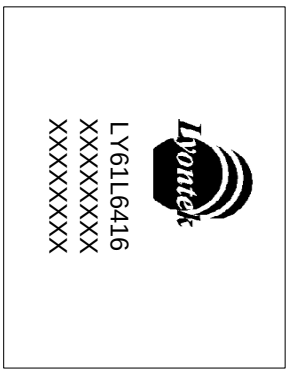
PIN CONFIGURATION



TSOP II



TFBGA (See through with Top View)



TFBGA(Top View)

ABSOLUTE MAXIMUN RATINGS*

PARAMETER	SYMBOL	RATING	UNIT
Voltage on V_{CC} relative to V_{SS}	V_{T1}	-0.5 to 4.6	V
Voltage on any other pin relative to V_{SS}	V_{T2}	-0.5 to V_{CC}+0.5	V
Operating Temperature	T_A	0 to 70(C grade)	℃
		-20 to 80(E grade)	
		-40 to 85(I grade)	
Storage Temperature	T_{STG}	-65 to 150	℃
Power Dissipation	P_D	1	W
DC Output Current	I_{OUT}	50	mA

*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 or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to the absolute maximum rating conditions for extended period may affect device reliability.

TRUTH TABLE

MODE	CE#	OE#	WE#	LB#	UB#	I/O OPERATION		SUPPLY CURRENT
						DQ0 - DQ7	DQ8 - DQ15	
Standby	H	X	X	X	X	High-Z	High-Z	I_{SB},I_{SB1}
Output Disable	L	H	H	X	X	High-Z	High-Z	I_{CC}
	L	X	X	H	H	High-Z	High-Z	
Read	L	L	H	L	H	D_{OUT}	High-Z	I_{CC}
	L	L	H	H	L	High-Z	D_{OUT}	
	L	L	H	L	L	D_{OUT}	D_{OUT}	
Write	L	X	L	L	H	D_{IN}	High-Z	I_{CC}
	L	X	L	H	L	High-Z	D_{IN}	
	L	X	L	L	L	D_{IN}	D_{IN}	

Note: H = V_{IH}, L = V_{IL}, X = Don't care.

DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION		MIN.	TYP. *4	MAX.	UNIT
Supply Voltage	V_{CC}		-10	3.15	3.3	3.6	V
			-12/15	3.0	3.3	3.6	V
Input High Voltage	V_{IH}*1			2.0	-	V_{CC}+0.3	V
Input Low Voltage	V_{IL}*2			- 0.3	-	0.8	V
Input Leakage Current	I_{LI}	$V_{CC} \geqq V_{IN} \geqq V_{SS}$		- 1	-	1	µA
Output Leakage Current	I_{LO}	$V_{CC} \geqq V_{OUT} \geqq V_{SS}$, Output Disabled		- 1	-	1	µA
Output High Voltage	V_{OH}	I_{OH} = -4mA		2.4	-	-	V
Output Low Voltage	V_{OL}	I_{OL} = 8mA		-	-	0.4	V
Average Operating Power supply Current	I_{CC}	Cycle time = MIN. CE# = V_{IL} , $I_{I/O}$ = 0mA Other pins at V_{IH} or V_{IL}	-10	-	105	120	mA
			-12	-	95	100	mA
			-15	-	85	90	mA
Standby Power Supply Current	I_{SB}	CE# = V_{IH}, other pins at V_{IH} or V_{IL}		-	3	10	mA
	I_{SB1}	CE# $\geqq$ V_{CC} - 0.2V, Others at 0.2V or V_{CC} - 0.2V		-	0.6	3*5	mA

Notes:
1. V_{IH}(max) = V_{CC} + 3.0V for pulse width less than 10ns.
2. V_{IL}(min) = V_{SS} - 3.0V for pulse width less than 10ns.
3. Over/Undershoot specifications are characterized, not 100% tested.
4. Typical values are included for reference only and are not guaranteed or tested.
   Typical values are measured at V_{CC} = $V_{CC(TYP.)}$ and T_A = 25℃
5. 1mA for special request

CAPACITANCE (T_A = 25℃, f = 1.0MHz)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Input Capacitance	C_{IN}	-	6	pF
Input/Output Capacitance	$C_{I/O}$	-	8	pF

Note : These parameters are guaranteed by device characterization, but not production tested.

AC TEST CONDITIONS

Input Pulse Levels	0.2V to V_{CC} - 0.2V
Input Rise and Fall Times	3ns
Input and Output Timing Reference Levels	1.5V
Output Load	C_L = 30pF + 1TTL, I_{OH}/I_{OL} = -4mA/8mA

AC ELECTRICAL CHARACTERISTICS

(1) READ CYCLE

PARAMETER	SYM.	LY61L6416-10		LY61L6416-12		LY61L6416-15		UNIT
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
Read Cycle Time	t_{RC}	10	-	12	-	15	-	ns
Address Access Time	t_{AA}	-	10	-	12	-	15	ns
Chip Enable Access Time	t_{ACE}	-	10	-	12	-	15	ns
Output Enable Access Time	t_{OE}	-	5	-	6	-	7	ns
Chip Enable to Output in Low-Z	t_{CLZ}*	2	-	3	-	4	-	ns
Output Enable to Output in Low-Z	t_{OLZ}*	0	-	0	-	0	-	ns
Chip Disable to Output in High-Z	t_{CHZ}*	-	5	-	6	-	7	ns
Output Disable to Output in High-Z	t_{OHZ}*	-	5	-	6	-	7	ns
Output Hold from Address Change	t_{OH}	3	-	3	-	3	-	ns
LB#, UB# Access Time	t_{BA}	-	5	-	6	-	7	ns
LB#, UB# to High-Z Output	t_{BHZ}*	-	5	-	6	-	7	ns
LB#, UB# to Low-Z Output	t_{BLZ}*	0	-	0	-	0	-	ns

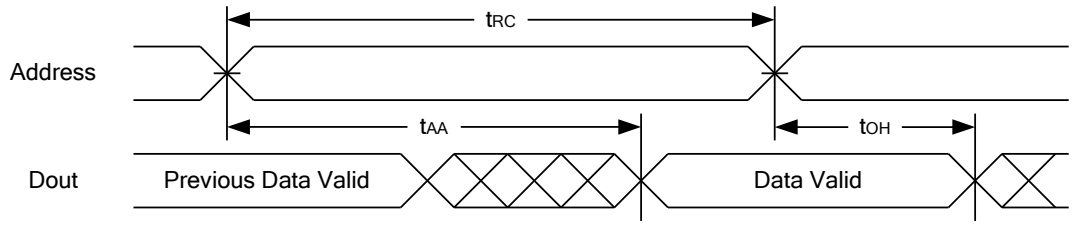
(2) WRITE CYCLE

PARAMETER	SYM.	LY61L6416-10		LY61L6416-12		LY61L6416-15		UNIT
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
Write Cycle Time	t_{WC}	10	-	12	-	15	-	ns
Address Valid to End of Write	t_{AW}	8	-	10	-	12	-	ns
Chip Enable to End of Write	t_{CW}	8	-	10	-	12	-	ns
Address Set-up Time	t_{AS}	0	-	0	-	0	-	ns
Write Pulse Width	t_{WP}	8	-	9	-	10	-	ns
Write Recovery Time	t_{WR}	0	-	0	-	0	-	ns
Data to Write Time Overlap	t_{DW}	6	-	7	-	8	-	ns
Data Hold from End of Write Time	t_{DH}	0	-	0	-	0	-	ns
Output Active from End of Write	t_{OW}*	2	-	3	-	4	-	ns
Write to Output in High-Z	t_{WHZ}*	-	6	-	7	-	8	ns
LB#, UB# Valid to End of Write	t_{BW}	8	-	10	-	12	-	ns

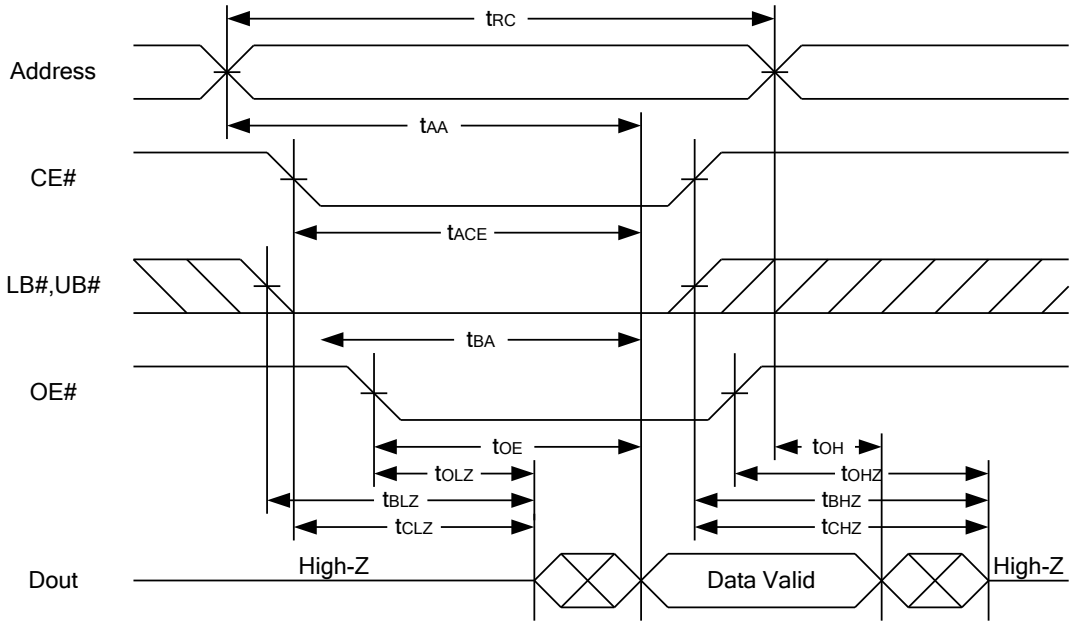
*These parameters are guaranteed by device characterization, but not production tested.

TIMING WAVEFORMS

READ CYCLE 1 (Address Controlled) (1,2)

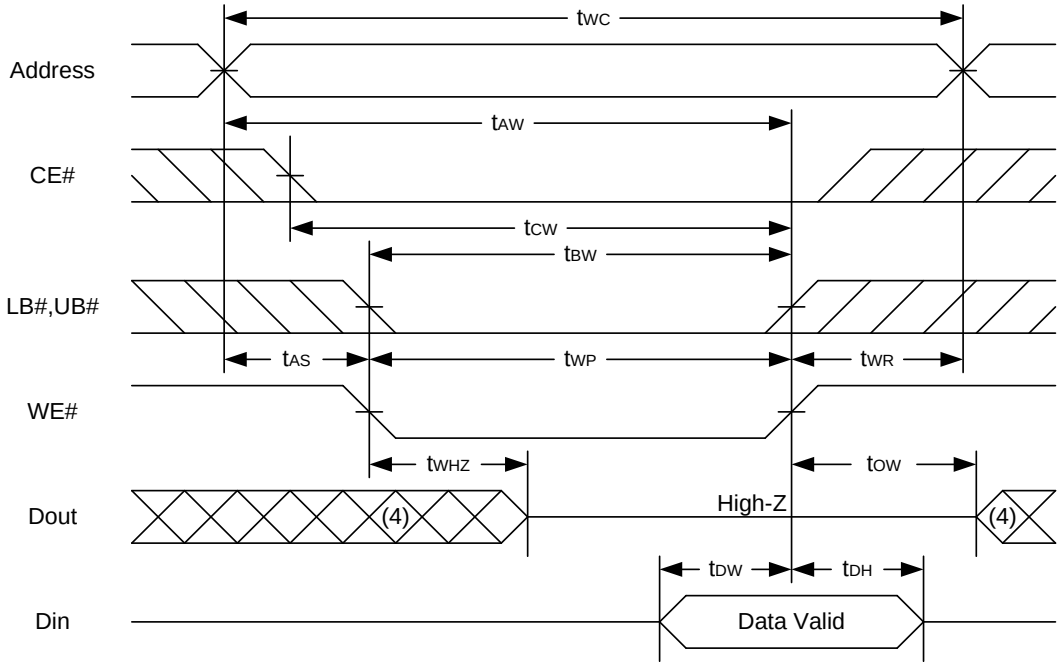


READ CYCLE 2 (CE# and OE# Controlled) (1,3,4,5)

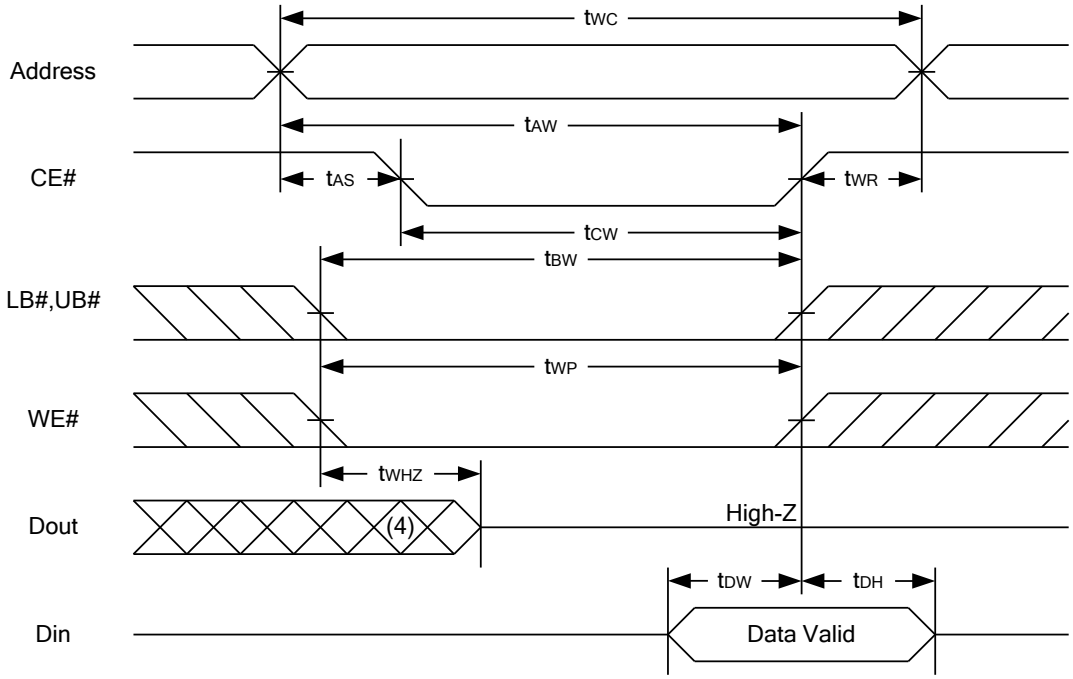


Notes :
1.WE# is high for read cycle.
2.Device is continuously selected OE# = low, CE# = low, LB# or UB# = low.
3.Address must be valid prior to or coincident with CE# = low, LB# or UB# = low transition; otherwise t_{AA} is the limiting parameter.
4.t_{CLZ}, t_{BLZ}, t_{OLZ}, t_{CHZ}, t_{BHZ} and t_{OHZ} are specified with C_L = 5pF. Transition is measured ±500mV from steady state.
5.At any given temperature and voltage condition, t_{CHZ} is less than t_{CLZ} , t_{BHZ} is less than t_{BLZ}, t_{OHZ} is less than t_{OLZ}.

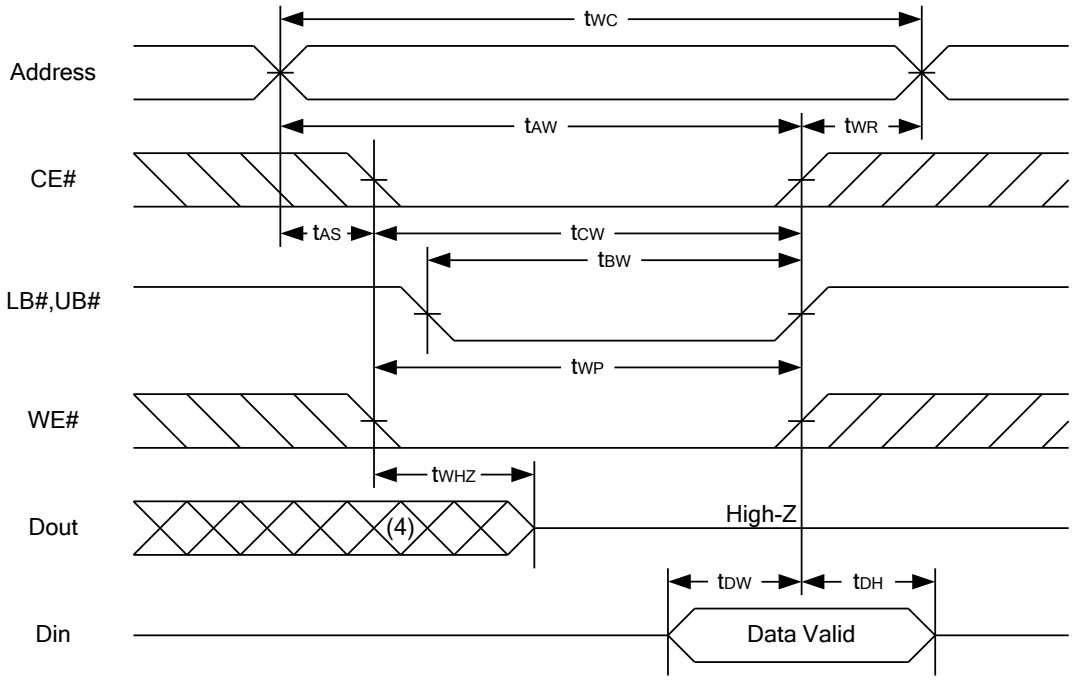
WRITE CYCLE 1 (WE# Controlled) (1,2,4,5)



WRITE CYCLE 2 (CE# Controlled) (1,4,5)



WRITE CYCLE 3 (LB#,UB# Controlled) (1,4,5)



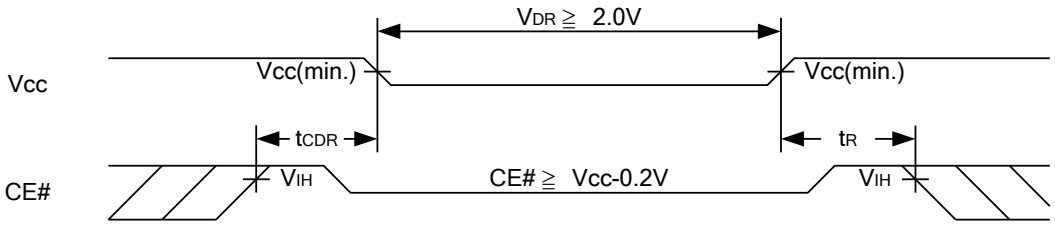
Notes :
1.A write occurs during the overlap of a low CE#, low WE#, LB# or UB# = low.
2.During a WE# controlled write cycle with OE# low, t_{WP} must be greater than $t_{WHZ} + t_{DW}$ to allow the drivers to turn off and data to be placed on the bus.
3.During this period, I/O pins are in the output state, and input signals must not be applied.
4.If the CE#, LB#, UB# low transition occurs simultaneously with or after WE# low transition, the outputs remain in a high impedance state.
5.t_{OW} and t_{WHZ} are specified with C_L = 5pF. Transition is measured ±500mV from steady state.

DATA RETENTION CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
V_{CC} for Data Retention	V_{DR}	CE# ≧ V_{CC} - 0.2V	2.0	-	3.6	V
Data Retention Current	I_{DR}	V_{CC} = 2.0V, CE# ≧ V_{CC} - 0.2V Others at 0.2V or V_{CC} - 0.2V	-	0.4	2	mA
Chip Disable to Data Retention Time	t_{CDR}	See Data Retention Waveforms (below)	0	-	-	ns
Recovery Time	t_R		t_{RC*}	-	-	ns

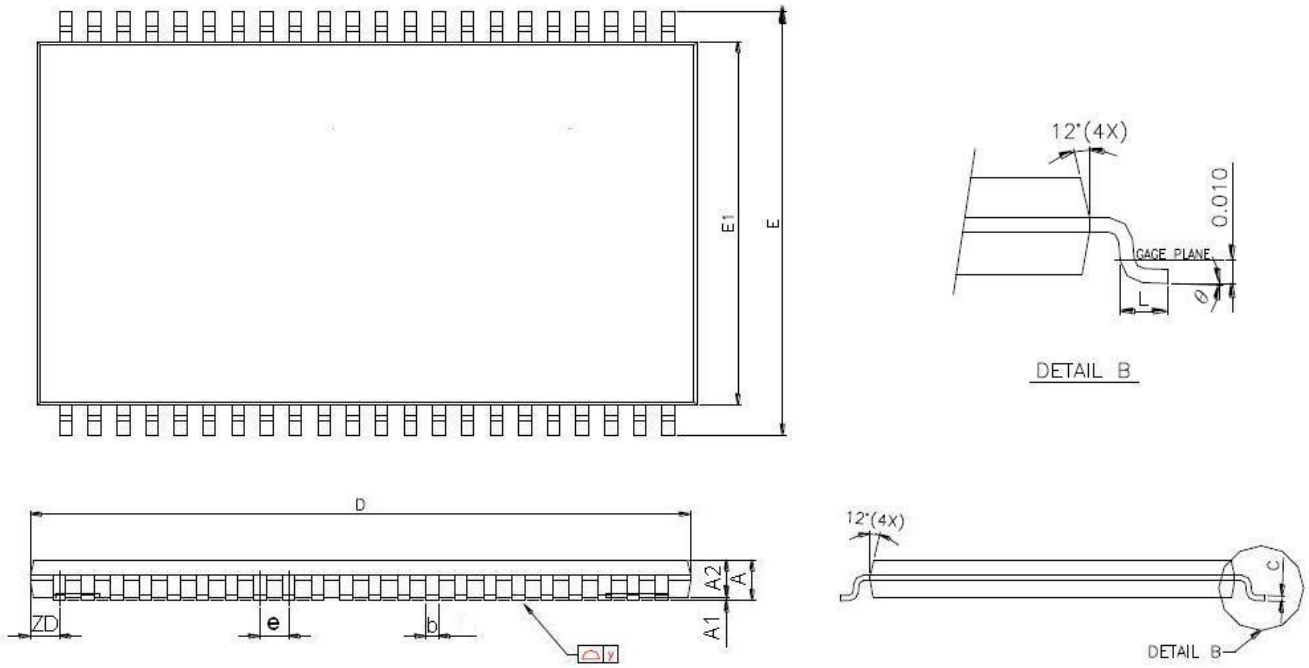
t_{RC*} = Read Cycle Time

DATA RETENTION WAVEFORM



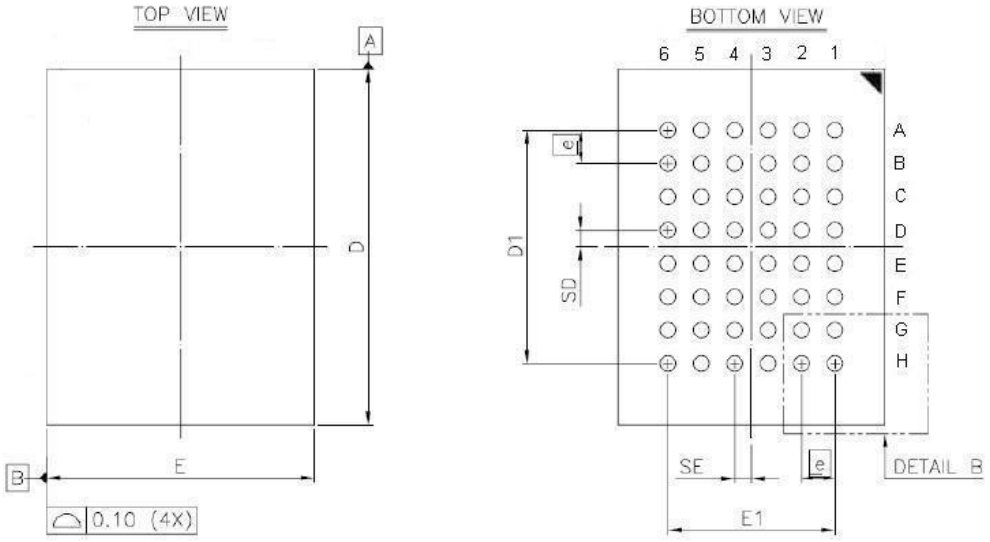
PACKAGE OUTLINE DIMENSION

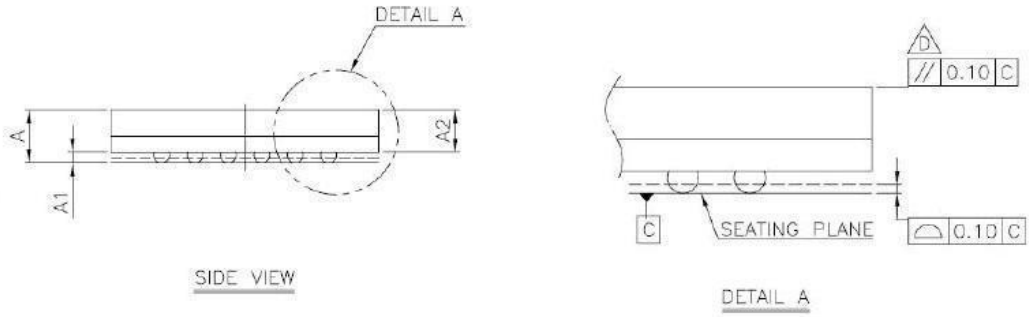
44-pin 400mil TSOP Ⅱ Package Outline Dimension



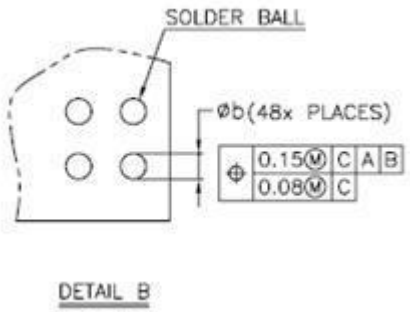
SYMBOLS	DIMENSIONS IN MILLMETERS			DIMENSIONS IN MILS		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	-	-	1.20	-	-	47.2
A1	0.05	0.10	0.15	2.0	3.9	5.9
A2	0.95	1.00	1.05	37.4	39.4	41.3
b	0.30	-	0.45	11.8	-	17.7
c	0.12	-	0.21	4.7	-	8.3
D	18.212	18.415	18.618	717	725	733
E	11.506	11.760	12.014	453	463	473
E1	9.957	10.160	10.363	392	400	408
e	-	0.800	-	-	31.5	-
L	0.40	0.50	0.60	15.7	19.7	23.6
ZD	-	0.805	-	-	31.7	-
y	-	-	0.076	-	-	3
θ	0°	3°	6°	0°	3°	6°

48-ball 6mm × 8mm TFBGA Package Outline Dimension





SYM.	DIMENSION (mm)			DIMENSION (inch)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	—	—	1.20	—	—	0.047
A1	0.20	0.25	0.30	0.008	0.010	0.012
A2	—	—	0.94	—	—	0.037
b	0.30	0.35	0.40	0.012	0.014	0.016
C B D	7.95	8.00	8.05	0.313	0.315	0.317
D1	5.25 BSC			0.207 BSC		
C B E	5.95	6.00	6.05	0.234	0.236	0.238
E1	3.75 BSC			0.148 BSC		
SE	0.375 TYP			0.015 TYP		
SD	0.375 TYP			0.015 TYP		
e	0.75 BSC			0.030 BSC		



NOTE:
1. CONTROLLING DIMENSION : MILLIMETER.
2. REFERENCE DOCUMENT : JEDEC MO-207.

ORDERING INFORMATION

Package Type	Access Time (Speed)(ns)	Temperature Range(℃)	Packing Type	Lyontek Item No.
44-pin (400mil) TSOP II	10	0℃~70℃	Tray	LY61L6416ML-10
			Tape Reel	LY61L6416ML-10T
		-20℃~80℃	Tray	LY61L6416ML-10E
			Tape Reel	LY61L6416ML-10ET
		-40℃~85℃	Tray	LY61L6416ML-10I
			Tape Reel	LY61L6416ML-10IT
	12	0℃~70℃	Tray	LY61L6416ML-12
			Tape Reel	LY61L6416ML-12T
		-20℃~80℃	Tray	LY61L6416ML-12E
			Tape Reel	LY61L6416ML-12ET
		-40℃~85℃	Tray	LY61L6416ML-12I
			Tape Reel	LY61L6416ML-12IT
	15	0℃~70℃	Tray	LY61L6416ML-15
			Tape Reel	LY61L6416ML-15T
		-20℃~80℃	Tray	LY61L6416ML-15E
			Tape Reel	LY61L6416ML-15ET
		-40℃~85℃	Tray	LY61L6416ML-15I
			Tape Reel	LY61L6416ML-15IT

ORDERING INFORMATION

Package Type	Access Time (Speed)(ns)	Temperature Range(℃)	Packing Type	Lyontek Item No.
48-ball (6mm x 8mm) TFBGA	10	0℃~70℃	Tray	LY61L6416GL-10
			Tape Reel	LY61L6416GL-10T
		-20℃~80℃	Tray	LY61L6416GL-10E
			Tape Reel	LY61L6416GL-10ET
		-40℃~85℃	Tray	LY61L6416GL-10I
			Tape Reel	LY61L6416GL-10IT
	12	0℃~70℃	Tray	LY61L6416GL-12
			Tape Reel	LY61L6416GL-12T
		-20℃~80℃	Tray	LY61L6416GL-12E
			Tape Reel	LY61L6416GL-12ET
		-40℃~85℃	Tray	LY61L6416GL-12I
			Tape Reel	LY61L6416GL-12IT
	15	0℃~70℃	Tray	LY61L6416GL-15
			Tape Reel	LY61L6416GL-15T
		-20℃~80℃	Tray	LY61L6416GL-15E
			Tape Reel	LY61L6416GL-15ET
		-40℃~85℃	Tray	LY61L6416GL-15I
			Tape Reel	LY61L6416GL-15IT

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