64K x 16 HIGH-SPEED CMOS STATIC RAM

PRELIMINARY INFORMATION
APRIL 2003

FEATURES

- High-speed access time: 20 ns, 25ns
- CMOS low power operation:
  38 mW (typical) operating
  10 µW (typical) standby
- TTL compatible interface levels
- Single power supply:
  2.6V (-5%/+10%) (20ns)
  2.5V (-5%/+10%) (25ns)
- Fully static operation: no clock or refresh required
- Three state outputs
- Data control for upper and lower bytes
- Automotive temperature available

DESCRIPTION

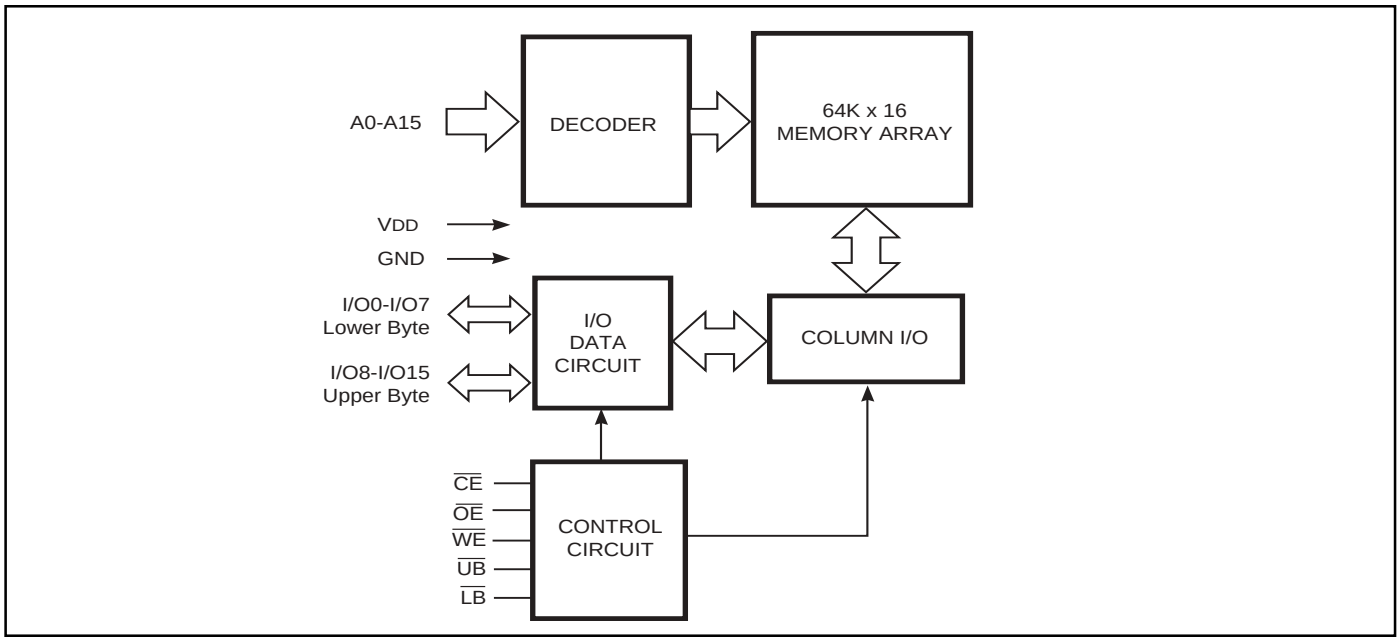
The *ISSI* IS64LV6416AL is a high-speed, 1,048,576-bit static RAM organized as 65,536 words by 16 bits. It is fabricated using *ISSI*'s high-performance CMOS technology. This highly reliable process coupled with innovative circuit design techniques, yields access times as fast as 20ns with low power consumption.

When $\overline{CE}$ is HIGH (deselected), the device assumes a standby mode at which the power dissipation can be reduced down with CMOS input levels.

Easy memory expansion is provided by using Chip Enable and Output Enable inputs, $\overline{CE}$ and $\overline{OE}$. The active LOW Write Enable ($\overline{WE}$) controls both writing and reading of the memory. A data byte allows Upper Byte ($\overline{UB}$) and Lower Byte ($\overline{LB}$) access.

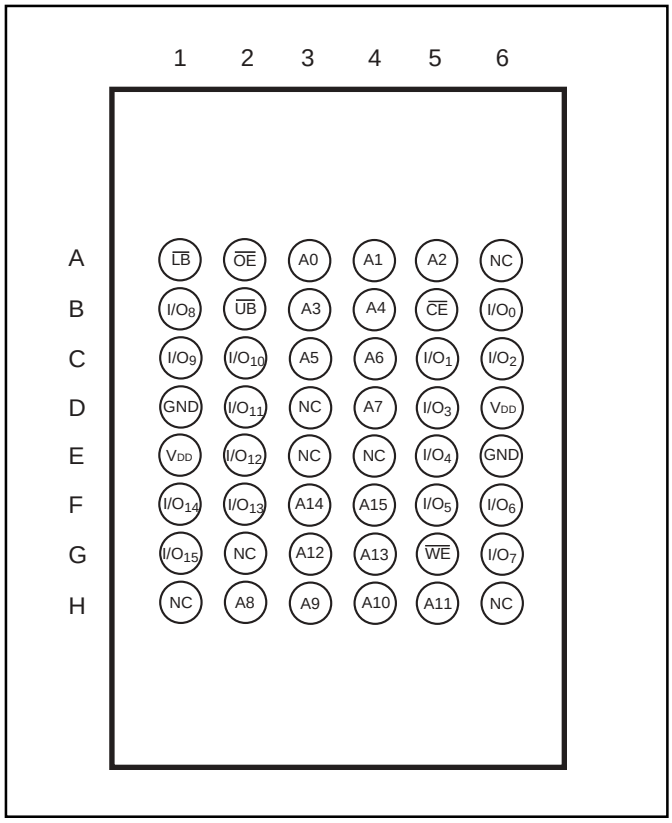
The IS64LV6416AL is packaged in the JEDEC standard 44-pin TSOP-II, and 48-pin mini BGA (6mm x 8mm).

FUNCTIONAL BLOCK DIAGRAM

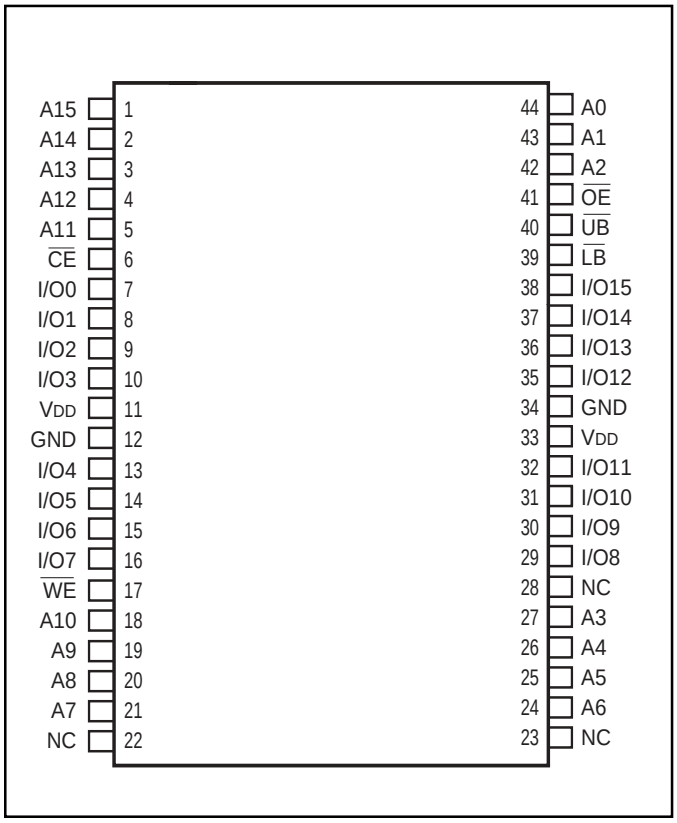


PIN CONFIGURATIONS

48-Pin mini BGA (6mm x 8mm)



44-Pin TSOP



PIN DESCRIPTIONS

A0-A15	Address Inputs
I/O0-I/O15	Data Inputs/Outputs
$\overline{CE}$	Chip Enable Input
$\overline{OE}$	Output Enable Input
$\overline{WE}$	Write Enable Input
$\overline{LB}$	Lower-byte Control (I/O0-I/O7)
$\overline{UB}$	Upper-byte Control (I/O8-I/O15)
NC	No Connection
V_{DD}	Power
GND	Ground

TRUTH TABLE

Mode	$\overline{WE}$	$\overline{CE}$	$\overline{OE}$	$\overline{LB}$	$\overline{UB}$	I/O PIN I/O0-I/O7	I/O PIN I/O8-I/O15	V_{DD} Current
Not Selected	X	H	X	X	X	High-Z	High-Z	I_{SB1}, I_{SB2}
Output Disabled	H	L	H	X	X	High-Z	High-Z	I_{CC}
	X	L	X	H	H	High-Z	High-Z	
Read	H	L	L	L	H	D_{OUT}	High-Z	I_{CC}
	H	L	L	H	L	High-Z	D_{OUT}	
	H	L	L	L	L	D_{OUT}	D_{OUT}	
Write	L	L	X	L	H	D_{IN}	High-Z	I_{CC}
	L	L	X	H	L	High-Z	D_{IN}	
	L	L	X	L	L	D_{IN}	D_{IN}	

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Parameter	Value	Unit
V_{TERM}	Terminal Voltage with Respect to GND	–0.5 to V_{DD}+0.5	V
T_{STG}	Storage Temperature	–65 to +150	°C
P_T	Power Dissipation	1.5	W
V_{DD}	V_{DD} Related to GND	-0.2 to +3.9	V

Note:

1. Stress 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.

OPERATING RANGE (V_{DD})

Option	Ambient Temperature	V_{DD} (20ns)	V_{DD} (25ns)
A1	–40°C to +85°C	2.6V -5%/+10%	2.5V -5%/+10%
A2	–40°C to +105°C	2.6V -5%/+10%	2.5V -5%/+10%
A3	–40°C to +125°C	2.6V -5%/+10%	2.5V -5%/+10%

DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{DD} = Min., I_{OH} = –1.0 mA	2.2	—	V
V_{OL}	Output LOW Voltage	V_{DD} = Min., I_{OL} = 1.0 mA	—	0.4	V
V_{IH}	Input HIGH Voltage		1.7	V_{DD} + 0.3	V
V_{IL}	Input LOW Voltage(1)		–0.3	0.7	V
I_{LI}	Input Leakage	GND ≤ V_{IN} ≤ V_{DD}	–1	1	µA
I_{LO}	Output Leakage	GND ≤ V_{OUT} ≤ V_{DD}, Outputs Disabled	–1	1	µA

Notes:
1. V_{IL} (min.) = –2.0V for pulse width less than 10 ns.

POWER SUPPLY CHARACTERISTICS(1) (Over Operating Range)

				-20 ns		-25 ns		
Symbol	Parameter	Test Conditions	Options	Min.	Max.	Min.	Max.	Unit
I_{CC}	V_{DD} Dynamic Operating Supply Current	V_{DD} = Max., I_{OUT} = 0 mA, f = f_{MAX}	A1	—	25	—	25	mA
			A2	—	30	—	25	
			A3	—	35	—	30	
			typ(2)	—	15	—	12	
I_{CC1}	Operating Supply Current	V_{DD} = Max., Iout = 0mA, f = 0	A1	—	5	—	5	mA
			A2	—	5	—	5	
			A3	—	10	—	10	
I_{SB1}	TTL Standby Current (TTL Inputs)	V_{DD} = Max., V_{IN} = V_{IH} or V_{IL} $\overline{CE}$ ≥ V_{IH}, f = 0	A1	—	2	—	2	mA
			A2	—	3	—	3	
			A3	—	4	—	4	
I_{SB2}	CMOS Standby Current (CMOS Inputs)	V_{DD} = Max., $\overline{CE}$ ≥ V_{DD} – 0.2V, V_{IN} ≥ V_{DD} – 0.2V, or V_{IN} ≤ 0.2V, f = 0	A1	—	20	—	20	uA
			A2	—	20	—	20	
			A3	—	25	—	25	
			typ(2)	—	4	—	4	

Note:
1. At f = f_{MAX}, address and data inputs are cycling at the maximum frequency, f = 0 means no input lines change.
2. Typical values are measured at V_{DD}=2.5V, T_A=25°C. Not 100% tested.

CAPACITANCE(1)

Symbol	Parameter	Conditions	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	6	pF
C_{OUT}	Input/Output Capacitance	V_{OUT} = 0V	8	pF

Note:
1. Tested initially and after any design or process changes that may affect these parameters.

AC TEST CONDITIONS

Parameter	Unit
Input Pulse Level	0V to 2.5V
Input Rise and Fall Times	1.5ns
Input and Output Timing and Reference Level (V_{Ref})	1.25V
Output Load	See Figures 1a and 1b

AC TEST LOADS

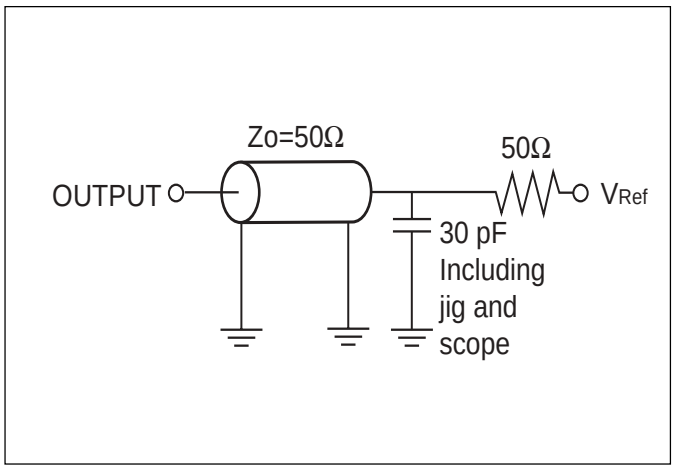


Figure 1a.

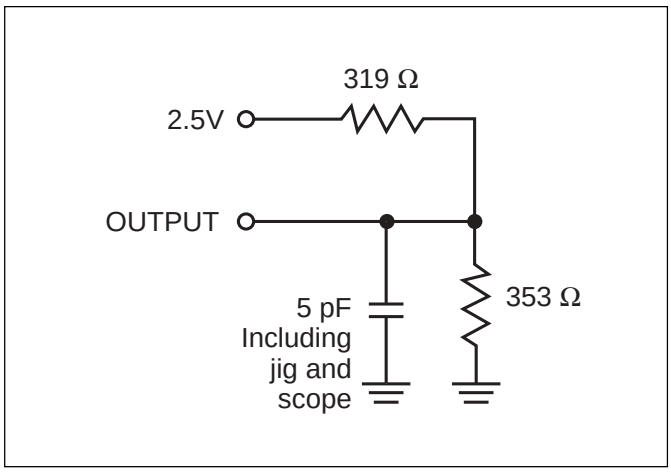


Figure 1b.

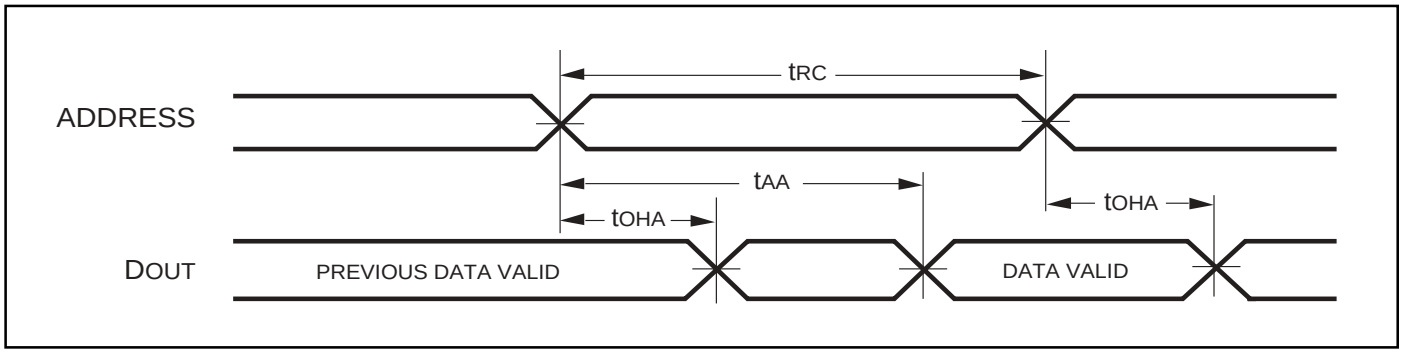
READ CYCLE SWITCHING CHARACTERISTICS[1] (Over Operating Range)

Symbol	Parameter	-20 ns Min.	-20 ns Max.	-25 ns Min.	-25 ns Max.	Unit
t_{RC}	Read Cycle Time	20	—	25	—	ns
t_{AA}	Address Access Time	—	20	—	25	ns
t_{OHA}	Output Hold Time	3	—	3	—	ns
t_{ACE}	$\overline{CE}$ Access Time	—	20	—	25	ns
t_{DOE}	$\overline{OE}$ Access Time	—	8	—	10	ns
t_{HZOE}[2]	$\overline{OE}$ to High-Z Output	0	8	0	10	ns
t_{LZOE}[2]	$\overline{OE}$ to Low-Z Output	0	—	0	—	ns
t_{HZCE}[2	$\overline{CE}$ to High-Z Output	0	8	0	10	ns
t_{LZCE}[2]	$\overline{CE}$ to Low-Z Output	3	—	3	—	ns
t_{BA}	$\overline{LB}$, $\overline{UB}$ Access Time	—	8	—	10	ns
t_{HZB}	$\overline{LB}$, $\overline{UB}$ to High-Z Output	0	8	0	10	ns
t_{LZB}	$\overline{LB}$, $\overline{UB}$ to Low-Z Output	0	—	0	—	ns

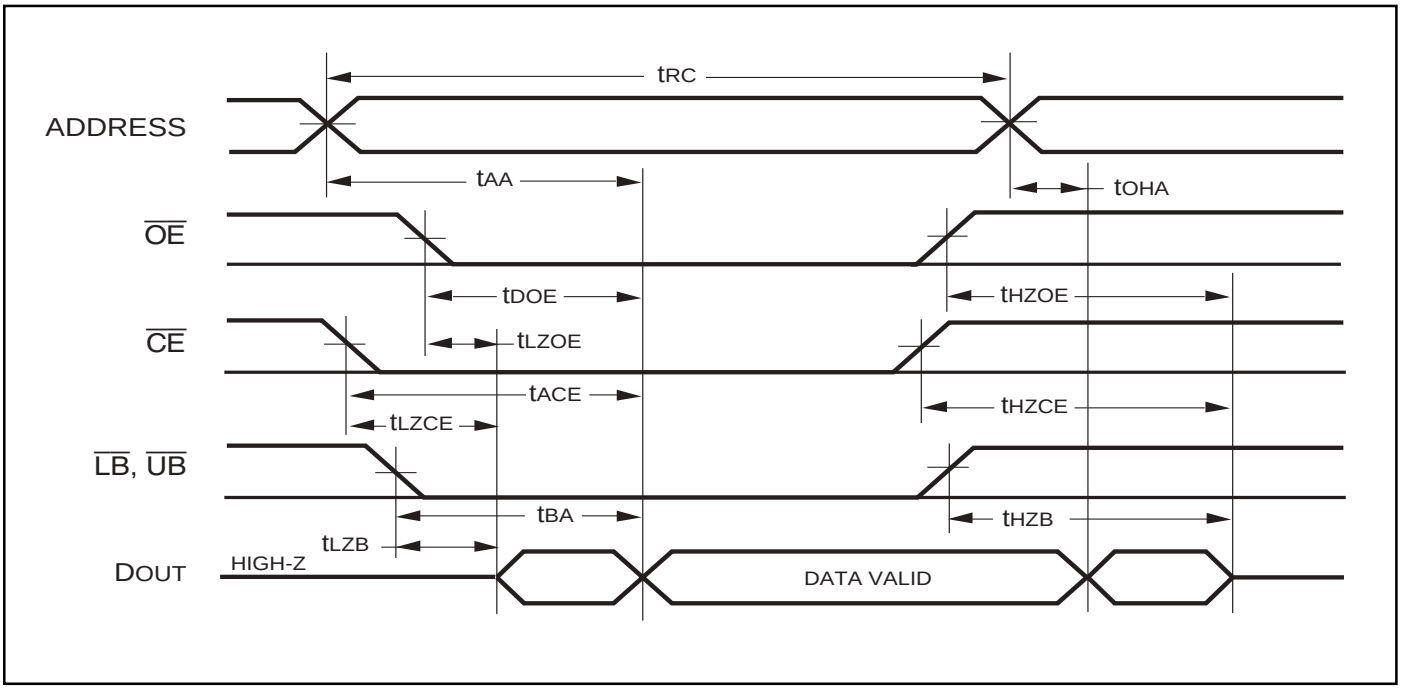
Notes:
1. Test conditions assume signal transition times of 1.5 ns or less, timing reference levels of 1.25V, input pulse levels of 0 to 2.50V and output loading specified in Figure 1a.
2. Tested with the load in Figure 1b. Transition is measured ±500 mV from steady-state voltage. Not 100% tested.
3. Not 100% tested.

AC WAVEFORMS

READ CYCLE NO. 1[1,2] (Address Controlled) ($\overline{CS}$ = $\overline{OE}$ = V_{IL}, $\overline{UB}$ or $\overline{LB}$ = V_{IL})



READ CYCLE NO. 2[1,3]



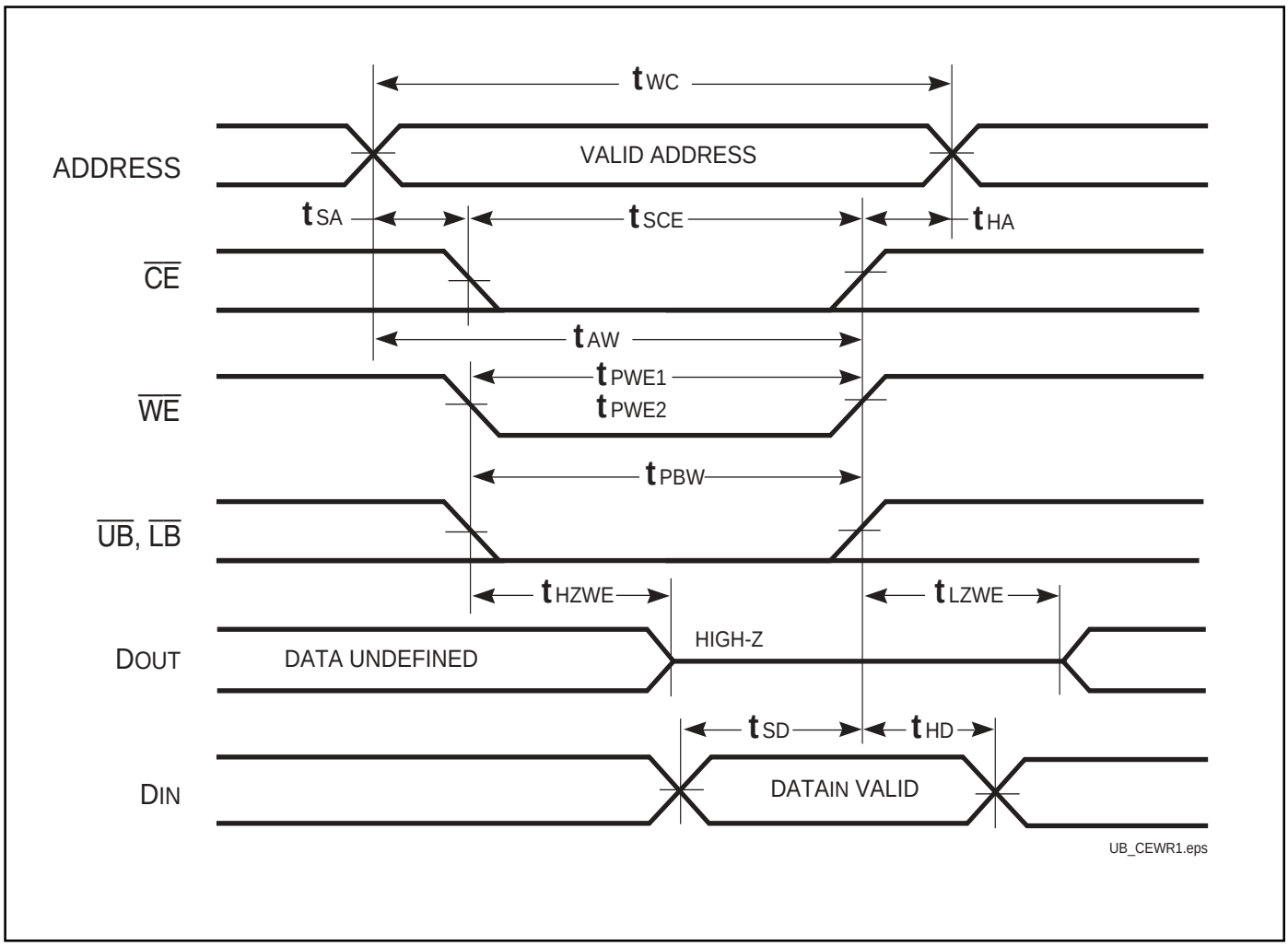
Notes:
1. $\overline{WE}$ is HIGH for a Read Cycle.
2. The device is continuously selected. $\overline{OE}$, $\overline{CE}$, $\overline{UB}$, or $\overline{LB}$ = V_{IL}.
3. Address is valid prior to or coincident with $\overline{CE}$ LOW transition.

WRITE CYCLE SWITCHING CHARACTERISTICS[1,2] (Over Operating Range)

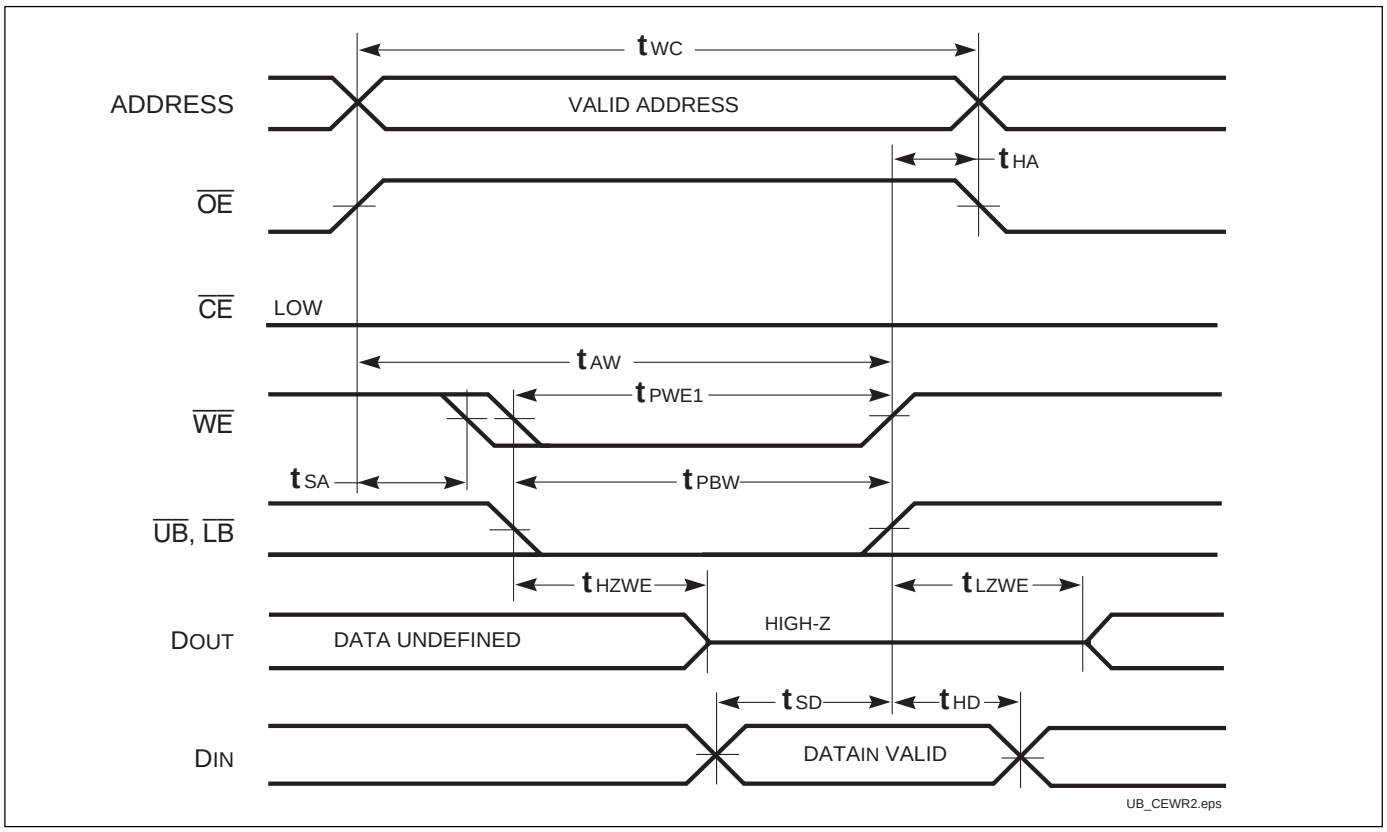
Symbol	Parameter	-20 ns Min.	-20 ns Max.	-25 ns Min.	-25 ns Max.	Unit
t_{WC}	Write Cycle Time	20	—	25	—	ns
t_{SCE}	$\overline{CE}$ to Write End	12	—	15	—	ns
t_{AW}	Address Setup Time to Write End	12	—	15	—	ns
t_{HA}	Address Hold from Write End	0	—	0	—	ns
t_{SA}	Address Setup Time	0	—	0	—	ns
t_{PWB}	$\overline{LB}$, $\overline{UB}$ Valid to End of Write	12	—	15	—	ns
t_{PWE1}	$\overline{WE}$ Pulse Width ($\overline{OE}$ = HIGH)	12	—	15	—	ns
t_{PWE2}	$\overline{WE}$ Pulse Width ($\overline{OE}$ = LOW)	17	—	19	—	ns
t_{SD}	Data Setup to Write End	9	—	11	—	ns
t_{HD}	Data Hold from Write End	0	—	0	—	ns
t_{HZWE}[3]	$\overline{WE}$ LOW to High-Z Output	—	9	—	11	ns
t_{LZWE}[3]	$\overline{WE}$ HIGH to Low-Z Output	3	—	5	—	ns

Notes:
1. Test conditions for IS64LV6416AL assume signal transition times of 1.5ns or less, timing reference levels of 1.25V, input pulse levels of 0 to 2.5V and output loading specified in Figure 1a.
2. Tested with the load in Figure 1b. Transition is measured ±500 mV from steady-state voltage. Not 100% tested.
3. The internal write time is defined by the overlap of $\overline{CE}$ LOW and $\overline{UB}$ or $\overline{LB}$, and $\overline{WE}$ LOW. All signals must be in valid states to initiate a Write, but any one can go inactive to terminate the Write. The Data Input Setup and Hold timing are referenced to the rising or falling edge of the signal that terminates the write.

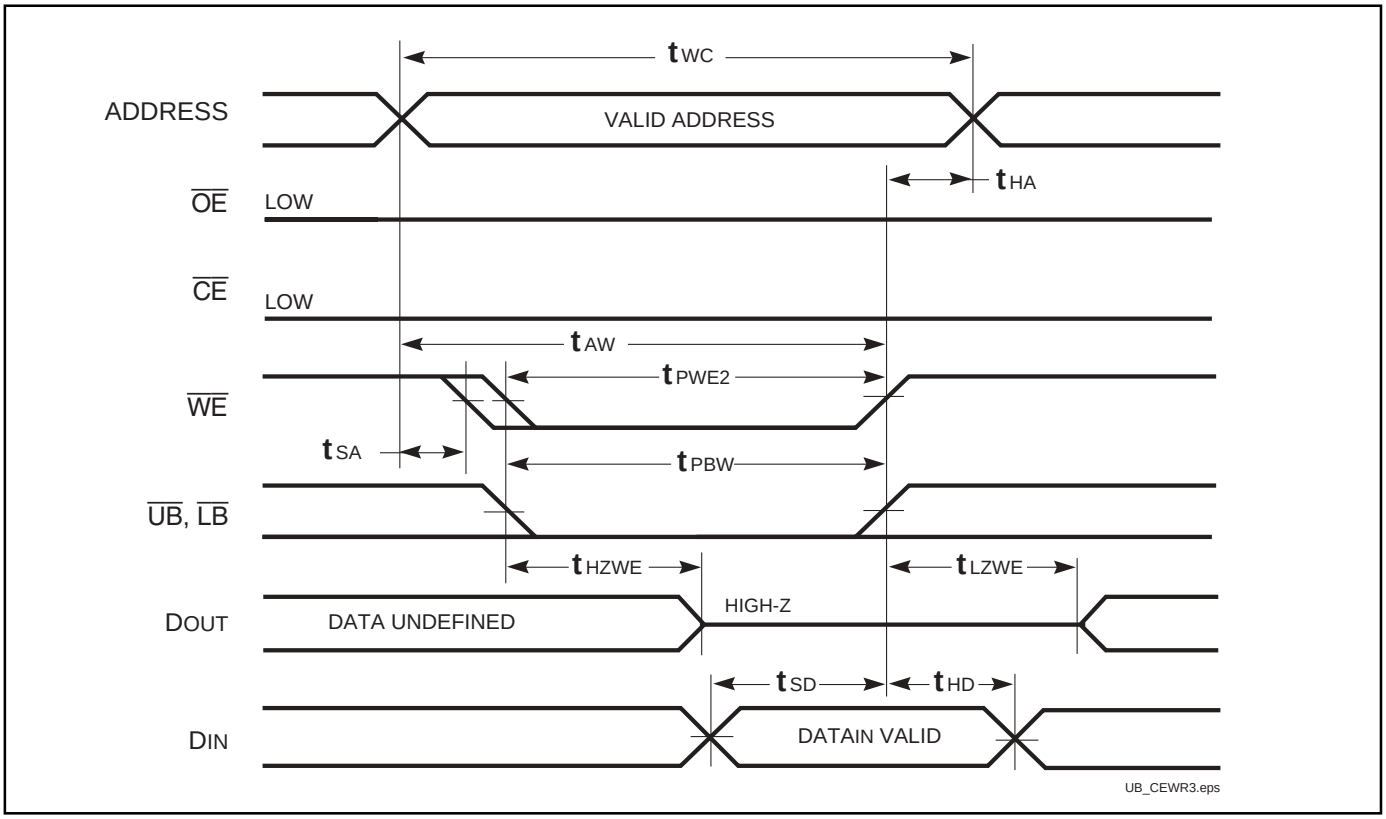
WRITE CYCLE NO. 1[1,2] ($\overline{CE}$ Controlled, $\overline{OE}$ = HIGH or LOW)



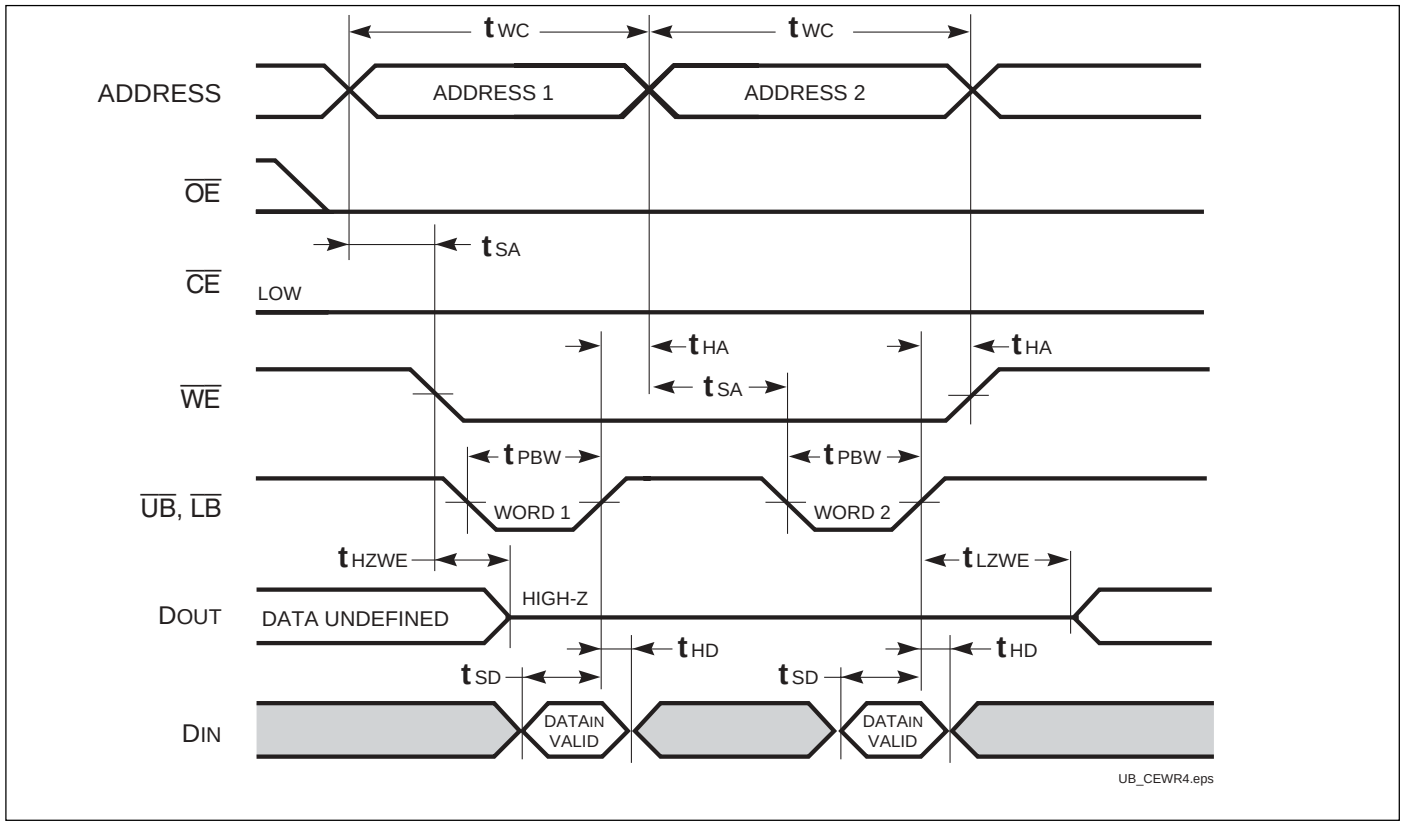
WRITE CYCLE NO. 2[1] ($\overline{WE}$ Controlled, $\overline{OE}$ = HIGH during Write Cycle)



WRITE CYCLE NO. 3 ($\overline{WE}$ Controlled: $\overline{OE}$ is LOW During Write Cycle)



WRITE CYCLE NO. 4 ($\overline{LB}$, $\overline{UB}$ Controlled, Back-to-Back Write) (1,3)



Notes:

1. The internal Write time is defined by the overlap of $\overline{CE}$ = LOW, $\overline{UB}$ and/or $\overline{LB}$ = LOW, and $\overline{WE}$ = LOW. All signals must be in valid states to initiate a Write, but any can be deasserted to terminate the Write. The t_{SA}, t_{HA}, t_{SD}, and t_{HD} timing is referenced to the rising or falling edge of the signal that terminates the Write.
2. Tested with $\overline{OE}$ HIGH for a minimum of 4 ns before $\overline{WE}$ = LOW to place the I/O in a HIGH-Z state.
3. $\overline{WE}$ may be held LOW across many address cycles and the $\overline{LB}$, $\overline{UB}$ pins can be used to control the Write function.

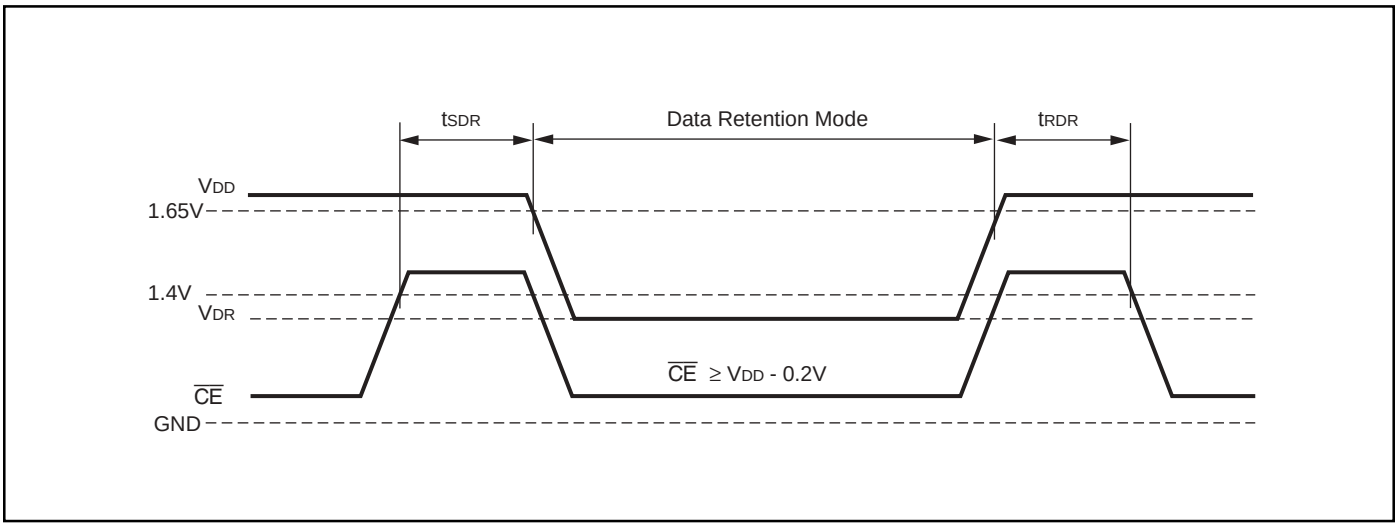
DATA RETENTION SWITCHING CHARACTERISTICS

Symbol	Parameter	Test Condition	Operations	Min.	Typ.(1)	Max.	Unit
V_{DR}	V_{DD} for Data Retention	See Data Retention Waveform		1.2	—	3.6	V
I_{DR}	Data Retention Current	V_{DD} = 1.2V, $\overline{CE} \geq V_{DD} - 0.2V$	A1	—	4	20	µA
			A2	—	4	20	
			A3	—	4	25	
t_{SDR}	Data Retention Setup Time	See Data Retention Waveform		0	—	—	ns
t_{RDR}	Recovery Time	See Data Retention Waveform		t_{RC}	—	—	ns

Note:

1. Typical values are measured at V_{DD} = 2.5V, T_A = 25°C. Not 100% tested.

DATA RETENTION WAVEFORM ($\overline{CE}$ Controlled)



ORDERING INFORMATION

Temperature Range (A1): –40°C to +85°C

Speed (ns)	Order Part No.	Package
20	IS64LV6416AL-20TA1	Plastic TSOP
20	IS64LV6416AL-20BA1	mini BGA (6mm x 8mm)
25	IS64LV6416AL-25TA1	Plastic TSOP
25	IS64LV6416AL-25BA1	mini BGA (6mm x 8mm)

Temperature Range (A2): –40°C to +105°C

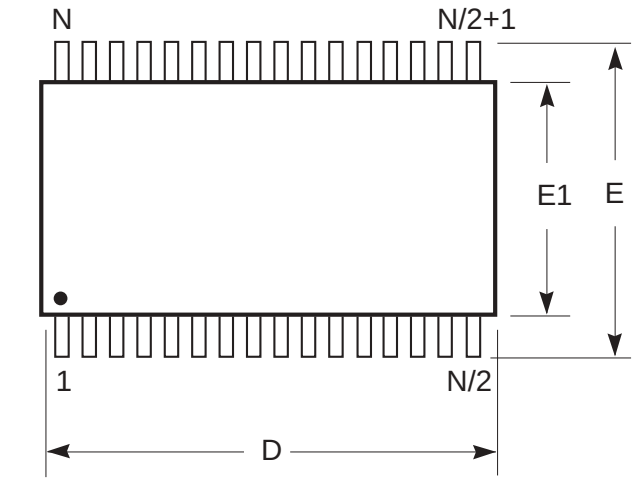
Speed (ns)	Order Part No.	Package
20	IS64LV6416AL-20TA2	Plastic TSOP
20	IS64LV6416AL-20BA2	mini BGA (6mm x 8mm)
25	IS64LV6416AL-25TA2	Plastic TSOP
25	IS64LV6416AL-25BA2	mini BGA (6mm x 8mm)

Temperature Range (A3): –40°C to +125°C

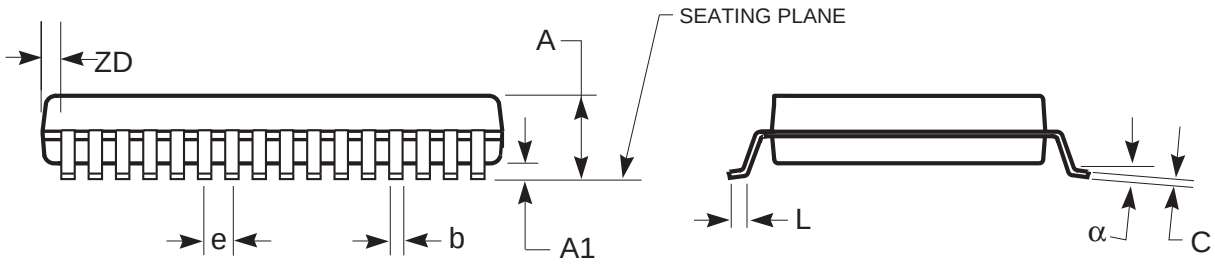
Speed (ns)	Order Part No.	Package
20	IS64LV6416AL-20TA3	Plastic TSOP
20	IS64LV6416AL-20BA3	mini BGA (6mm x 8mm)
25	IS64LV6416AL-25TA3	Plastic TSOP
25	IS64LV6416AL-25BA3	mini BGA (6mm x 8mm)

PACKAGING INFORMATION

Plastic TSOP
Package Code: T (Type II)



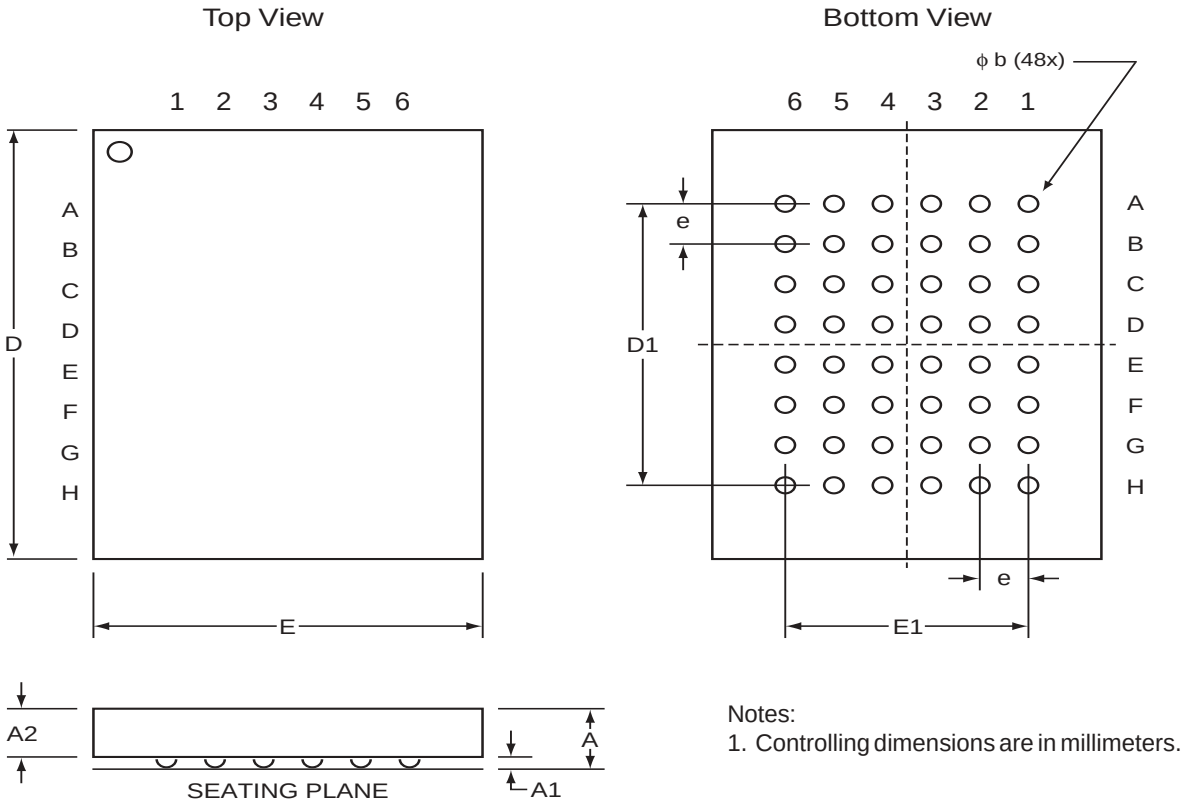
Notes:
1. Controlling dimension: millimieters, unless otherwise specified.
2. BSC = Basic lead spacing between centers.
3. Dimensions D and E1 do not include mold flash protrusions and should be measured from the bottom of the package.
4. Formed leads shall be planar with respect to one another within 0.004 inches at the seating plane.



Plastic TSOP (T - Type II)												
	Millimeters		Inches		Millimeters		Inches		Millimeters		Inches	
Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Ref. Std.												
No. Leads (N)	32				44				50			
A	—	1.20	—	0.047	—	1.20	—	0.047	—	1.20	—	0.047
A1	0.05	0.15	0.002	0.006	0.05	0.15	0.002	0.006	0.05	0.15	0.002	0.006
b	0.30	0.52	0.012	0.020	0.30	0.45	0.012	0.018	0.30	0.45	0.012	0.018
C	0.12	0.21	0.005	0.008	0.12	0.21	0.005	0.008	0.12	0.21	0.005	0.008
D	20.82	21.08	0.820	0.830	18.31	18.52	0.721	0.729	20.82	21.08	0.820	0.830
E1	10.03	10.29	0.391	0.400	10.03	10.29	0.395	0.405	10.03	10.29	0.395	0.405
E	11.56	11.96	0.451	0.466	11.56	11.96	0.455	0.471	11.56	11.96	0.455	0.471
e	1.27 BSC		0.050 BSC		0.80 BSC		0.032 BSC		0.80 BSC		0.031 BSC	
L	0.40	0.60	0.016	0.024	0.41	0.60	0.016	0.024	0.40	0.60	0.016	0.024
ZD	0.95 REF.		0.037 REF.		0.81 REF.		0.032 REF.		0.88 REF.		0.035 REF	
α	0°	5°	0°	5°	0°	5°	0°	5°	0°	5°	0°	5°

PACKAGING INFORMATION

Mini Ball Grid Array
Package Code: B (48-pin)



Notes:
1. Controlling dimensions are in millimeters.

mBGA - 6mm x 8mm

	MILLIMETERS			INCHES		
Sym.	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
N0. Leads		**48**				
A	—	—	1.20	—	—	0.047
A1	0.24	—	0.30	0.009	—	0.012
A2	0.60	—	—	0.024	—	—
D	7.90	—	8.10	0.311	—	0.319
D1		5.25 BSC			0.207 BSC	
E	5.90	—	6.10	0.232	—	0.240
E1		3.75 BSC			0.148 BSC	
e		0.75 BSC			0.030 BSC	
b	0.30	0.35	0.40	0.012	0.014	0.016

mBGA - 8mm x 10mm

	MILLIMETER			INCHES		
Sym.	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
N0. Leads		**48**				
A	—	—	1.20	—	—	0.047
A1	0.24	—	0.30	0.009	—	0.012
A2	0.60	—	—	0.024	—	—
D	9.90	—	10.10	0.390	—	0.398
D1		5.25 BSC			0.207 BSC	
E	7.90	—	8.10	0.311	—	0.319
E1		3.75 BSC			0.148 BSC	
e		0.75 BSC			0.030 BSC	
b	0.30	0.35	0.40	0.012	0.014	0.016