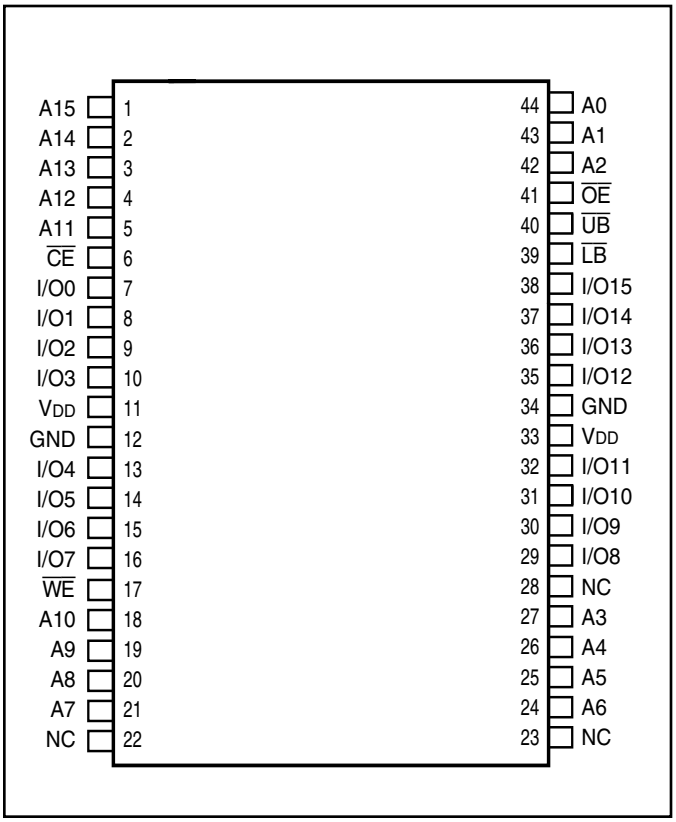
TRUTH TABLE

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}	

PIN CONFIGURATIONS

44-Pin TSOP-II

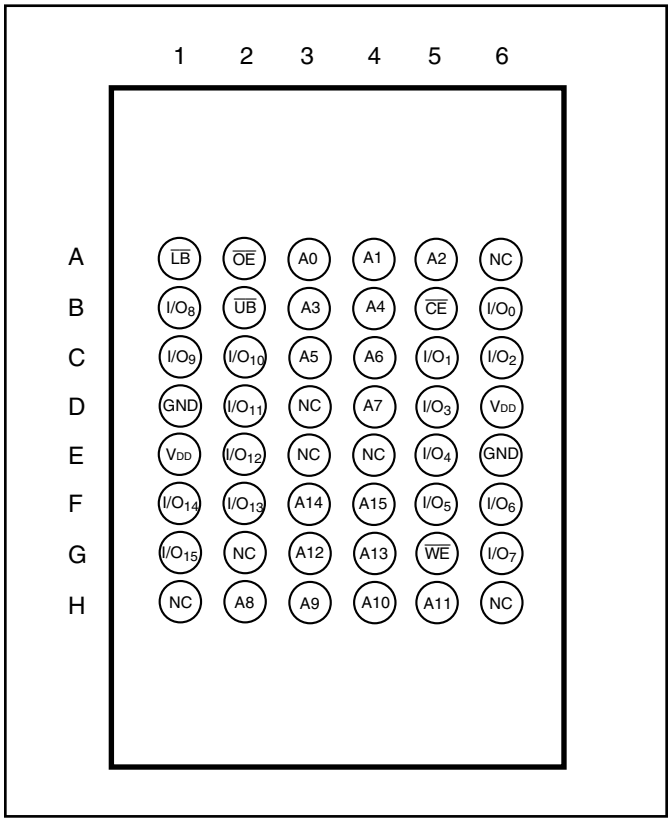


PIN DESCRIPTIONS

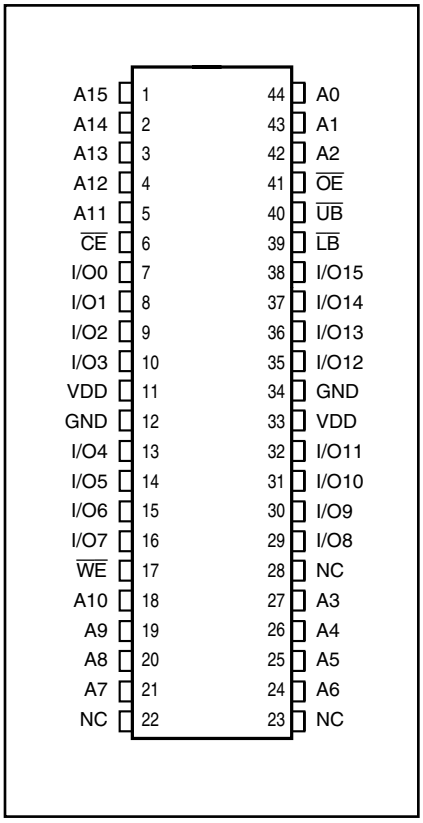
A0-A15	Address Inputs
I/O0-I/O15	Data Inputs/Outputs
$\overline{CE}$	Chip Enable Input
$\overline{OE}$	Output Enable Input
$\overline{WE}$	Write Enable Input
$\overline{LB}$	Lower-byte Control (I/O0-I/O7)
$\overline{UB}$	Upper-byte Control (I/O8-I/O15)
NC	No Connection
V_{DD}	Power
GND	Ground

PIN CONFIGURATIONS

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



44-Pin SOJ (K)



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

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Parameter	Value	Unit
V_{TERM}	Terminal Voltage with Respect to GND	–0.5 to V_{DD} + 0.5	V
V_{DD}	V_{DD} Relates to GND	–0.3 to 4.0	V
T_{STG}	Storage Temperature	–65 to +150	°C
P_T	Power Dissipation	1.0	W

Notes:
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.

CAPACITANCE(1,2)

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

Notes:
1. Tested initially and after any design or process changes that may affect these parameters.
2. Test conditions: T_A = 25°C, f = 1 MHz, V_{DD} = 3.3V.

ERROR DETECTION AND ERROR CORRECTION

- Independent ECC with hamming code for each byte
- Detect and correct one bit error per byte
- Better reliability than parity code schemes which can only detect an error but not correct an error
- Backward Compatible: Drop in replacement to current in industry standard devices (without ECC)

OPERATING RANGE (V_{DD})[1]

Range	Ambient Temperature	IS61WV6416EEBLL V_{DD} (8, 10ns)	IS64WV6416EEBLL V_{DD} (8, 10ns)
Industrial	–40°C to +85°C	2.4V-3.6V	—
Automotive (A1)	–40°C to +85°C	—	2.4V-3.6V (8,10ns)
Automotive (A3)	–40°C to +125°C	—	2.4V-3.6V (10ns)

Note:
1. Contact SRAM@issi.com for 1.8V option

DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

V_{DD} = 3.3V ± 10%

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{DD} = Min., I_{OH} = –4.0 mA	2.4	—	V
V_{OL}	Output LOW Voltage	V_{DD} = Min., I_{OL} = 8.0 mA	—	0.4	V
V_{IH}	Input HIGH Voltage		2	V_{DD} + 0.3	V
V_{IL}	Input LOW Voltage[1]		–0.3	0.8	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

Note:
1. V_{IL} (min.) = –0.3V DC; V_{IL} (min.) = –2.0V AC (pulse width < 2 ns). Not 100% tested.
   V_{IH} (max.) = V_{DD} + 0.3V DC; V_{IH} (max.) = V_{DD} + 2.0V AC (pulse width < 2 ns). Not 100% tested.

DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

V_{DD} = 2.4V-3.6V

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{DD} = Min., I_{OH} = –1.0 mA	1.8	—	V
V_{OL}	Output LOW Voltage	V_{DD} = Min., I_{OL} = 1.0 mA	—	0.4	V
V_{IH}	Input HIGH Voltage		2.0	V_{DD} + 0.3	V
V_{IL}	Input LOW Voltage[1]		–0.3	0.8	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

Note:
1. V_{IL} (min.) = –0.3V DC; V_{IL} (min.) = –2.0V AC (pulse width < 2 ns). Not 100% tested.
   V_{IH} (max.) = V_{DD} + 0.3V DC; V_{IH} (max.) = V_{DD} + 2.0V AC (pulse width < 2 ns). Not 100% tested.

POWER SUPPLY CHARACTERISTICS[1] (Over Operating Range)

				-8		-10		-20		
Symbol	Parameter	Test Conditions		Min.	Max.	Min.	Max.	Min.	Max.	Unit
I_{CC}	V_{DD} Dynamic Operating Supply Current	V_{DD} = Max., I_{OUT} = 0 mA, f = f_{MAX}	Com.	—	25	—	20	—	15	mA
			Ind.	—	30	—	25	—	20	
			Auto.	—	—	—	35	—	30	
			typ.[2]	15		15				
I_{CC1}	Operating Supply Current	V_{DD} = Max., I_{OUT} = 0 mA, f = 0	Com.	—	10	—	10	—	10	mA
			Ind.	—	12	—	12	—	12	
			Auto.	—	—	—	15	—	15	
I_{SB1}	TTL Standby Current (TTL Inputs)	V_{DD} = Max., V_{IN} = V_{IH} or V_{IL} $\overline{CE}$ ≥ V_{IH}, f = 0	Com.	—	10	—	10	—	10	mA
			Ind.	—	12	—	12	—	12	
			Auto.	—	—	—	20	—	20	
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	Com.	—	3	—	3	—	3	mA
			Ind.	—	4	—	4	—	4	
			Auto.	—	—	—	10	—	10	
			typ.[2]	1		1				

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} = 3.0V, T_A = 25°C and not 100% tested.

AC TEST CONDITIONS

Parameter	Unit (2.4V-3.6V)
Input Pulse Level	0.4V to V_{DD}-0.3V
Input Rise and Fall Times	1V/ ns
Input and Output Timing and Reference Level (V_{Ref})	V_{DD}/2
Output Load	See Figures 1 and 2

AC TEST LOADS

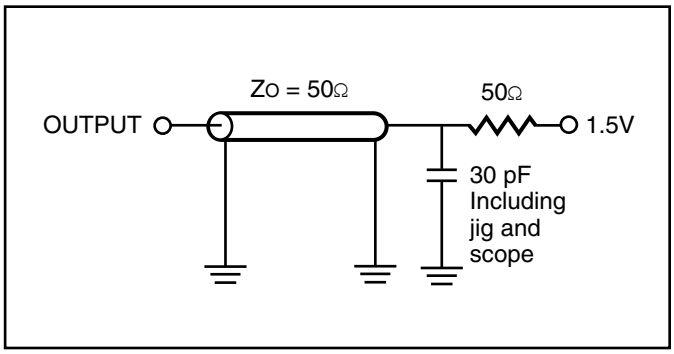


Figure 1.

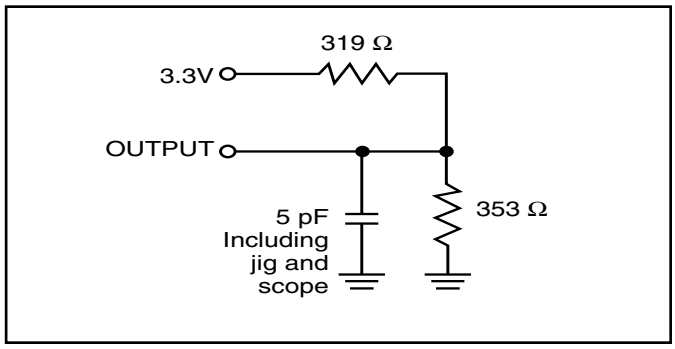


Figure 2.

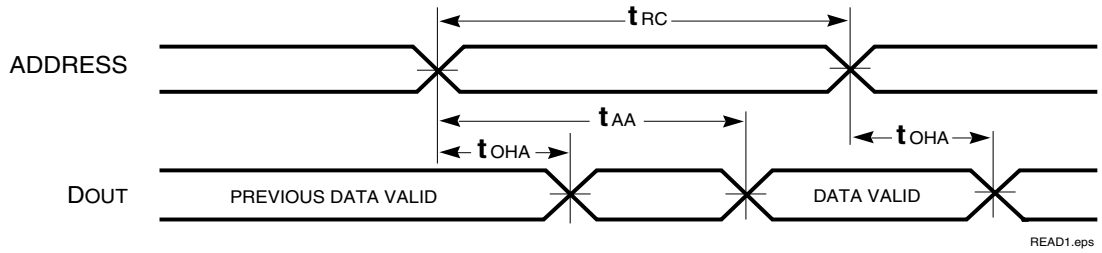
READ CYCLE SWITCHING CHARACTERISTICS[1] (Over Operating Range)

Symbol	Parameter	-8 Min.	-8 Max.	-10 Min.	-10 Max.	-20 Min.	-20 Max.	Unit
t_{RC}	Read Cycle Time	8	—	10	—	20	—	ns
t_{AA}	Address Access Time	—	8	—	10	—	20	ns
t_{OHA}	Output Hold Time	2.0	—	2.0	—	2.5	—	ns
t_{ACE}	$\overline{CE}$ Access Time	—	8	—	10	—	20	ns
t_{DOE}	$\overline{OE}$ Access Time	—	4.5	—	4.5	—	8	ns
t_{HZOE}[2]	$\overline{OE}$ to High-Z Output	—	3	—	4	0	8	ns
t_{LZOE}[2]	$\overline{OE}$ to Low-Z Output	0	—	0	—	0	—	ns
t_{HZCE}[2]	$\overline{CE}$ to High-Z Output	0	3	0	4	0	8	ns
t_{LZCE}[2]	$\overline{CE}$ to Low-Z Output	3	—	3	—	3	—	ns
t_{BA}	$\overline{LB}$, $\overline{UB}$ Access Time	—	5.5	—	6.5	—	8	ns
t_{HZB}[2]	$\overline{LB}$, $\overline{UB}$ to High-Z Output	0	3	0	3	0	8	ns
t_{LZB}[2]	$\overline{LB}$, $\overline{UB}$ to Low-Z Output	0	—	0	—	0	—	ns
t_{PU}	Power Up Time	0	—	0	—	0	—	ns
t_{PD}	Power Down Time	—	8	—	10	—	20	ns

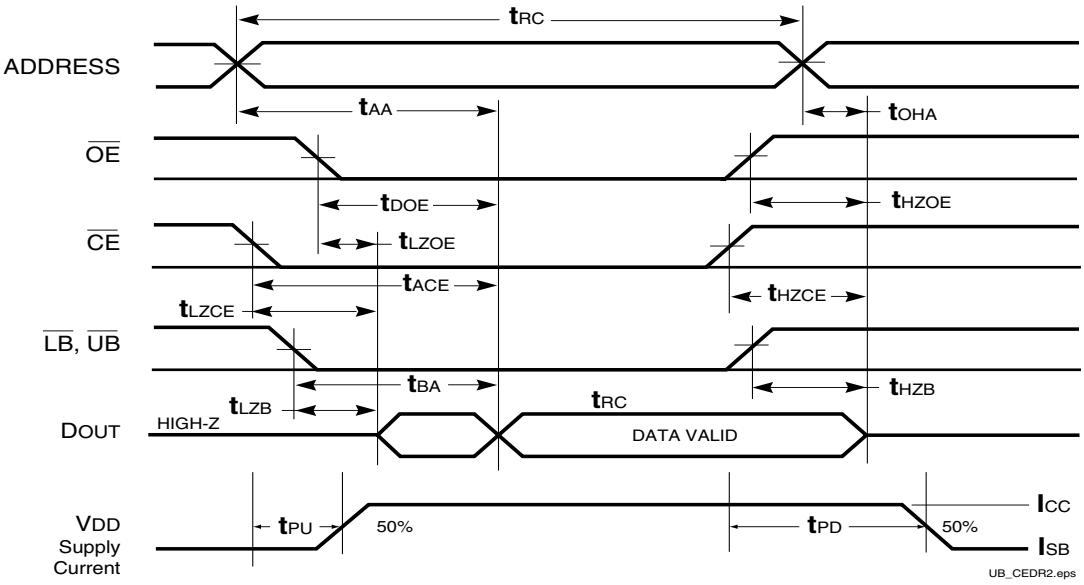
Notes:
1. Test conditions and output loading conditions are specified in the AC Test Conditions and AC Test Loads (Figure 1).
2. Tested with the load in Figure 2. Transition is measured ±500 mV from steady-state voltage.

AC WAVEFORMS

READ CYCLE NO. 1[1,2] (Address Controlled) ($\overline{CE}$ = $\overline{OE}$ = 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.

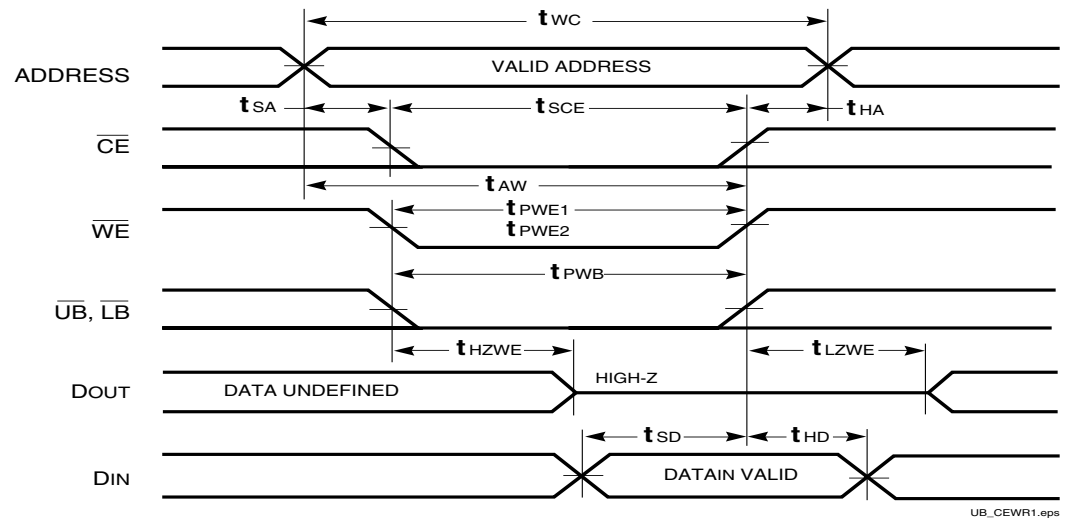
WRITE CYCLE SWITCHING CHARACTERISTICS[1,3] (Over Operating Range)

Symbol	Parameter	-8 Min.	-8 Max.	-10 Min.	-10 Max.	-20 Min.	-20 Max.	Unit
t_{WC}	Write Cycle Time	8	—	10	—	20	—	ns
t_{SCE}	$\overline{CE}$ to Write End	6.5	—	8	—	12	—	ns
t_{AW}	Address Setup Time to Write End	6.5	—	8	—	12	—	ns
t_{HA}	Address Hold from Write End	0	—	0	—	0	—	ns
t_{SA}	Address Setup Time	0	—	0	—	0	—	ns
t_{PWB}	$\overline{LB}$, $\overline{UB}$ Valid to End of Write	6.5	—	8	—	12	—	ns
t_{PWE1}	$\overline{WE}$ Pulse Width	6.5	—	8	—	12	—	ns
t_{PWE2}	$\overline{WE}$ Pulse Width ($\overline{OE}$ = LOW)	8	—	10	—	17	—	ns
t_{SD}	Data Setup to Write End	5	—	6	—	9	—	ns
t_{HD}	Data Hold from Write End	0	—	0	—	0	—	ns
t_{HZWE}[2]	$\overline{WE}$ LOW to High-Z Output	—	3.5	—	5	—	9	ns
t_{LZWE}[2]	$\overline{WE}$ HIGH to Low-Z Output	2	—	2	—	3	—	ns

Notes:
1. Test conditions and output loading conditions are specified in the AC Test Conditions and AC Test Loads (Figure 1).
2. Tested with the load in Figure 2. 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. Shaded area product in development

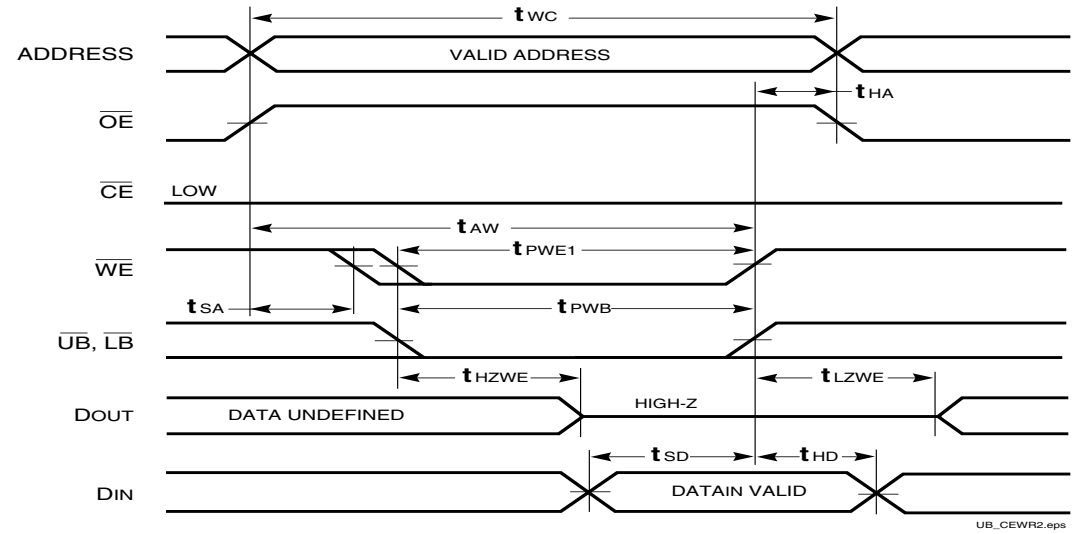
AC WAVEFORMS

WRITE CYCLE NO. 1 ($\overline{CE}$ Controlled, $\overline{OE}$ is HIGH or LOW) (1)



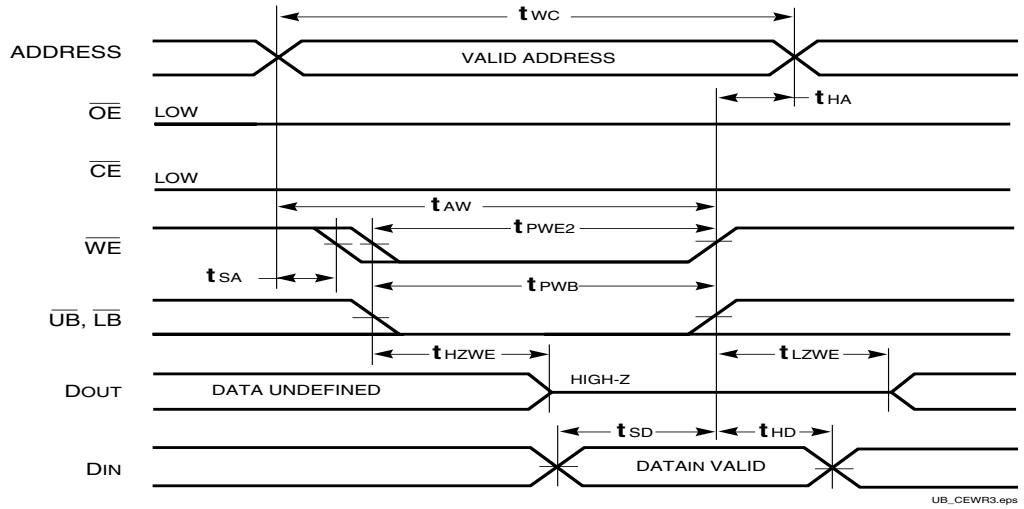
Notes:
1. WRITE is an internally generated signal asserted during an overlap of the LOW states on the $\overline{CE}$ and $\overline{WE}$ inputs and at least one of the $\overline{LB}$ and $\overline{UB}$ inputs being in the LOW state.
2. WRITE = ($\overline{CE}$) [($\overline{LB}$) = ($\overline{UB}$)] ($\overline{WE}$).

WRITE CYCLE NO. 2 ($\overline{WE}$ Controlled. $\overline{OE}$ is HIGH During Write Cycle) (1,2)

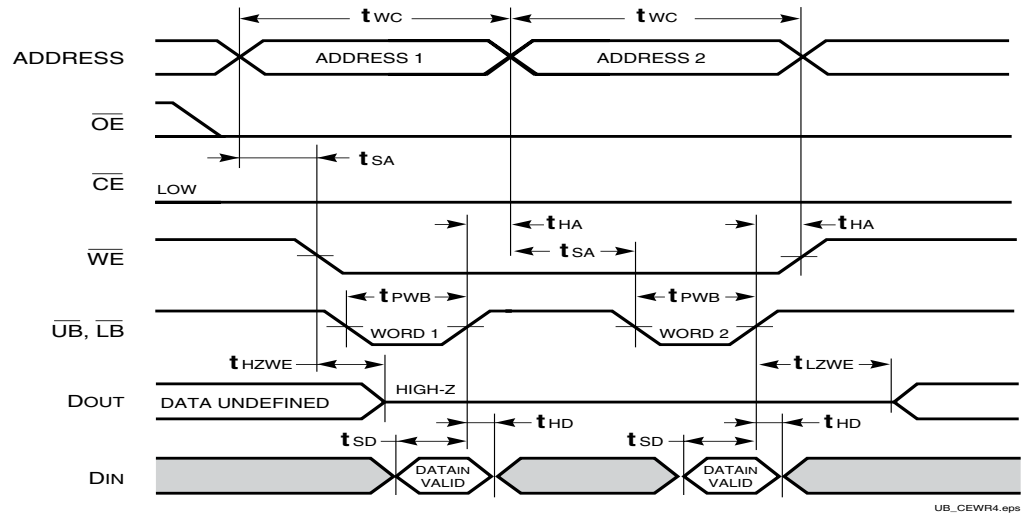


AC WAVEFORMS

WRITE CYCLE NO. 3 ($\overline{WE}$ Controlled. $\overline{OE}$ is LOW During Write Cycle) [1]



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.

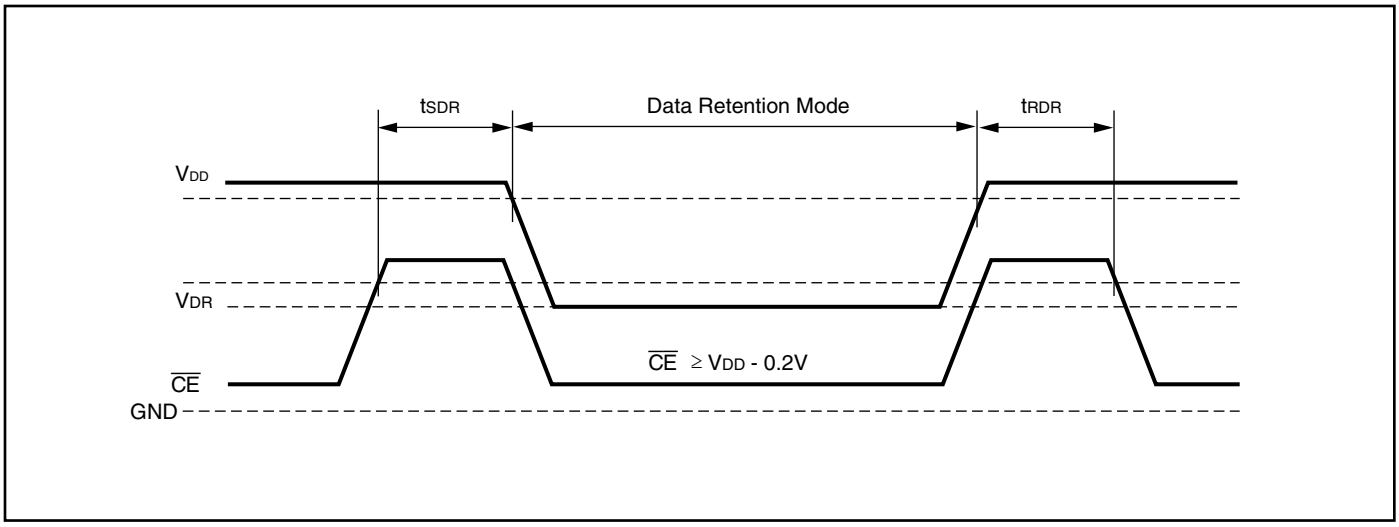
HIGH SPEED (IS61/64WV6416EEBLL)

DATA RETENTION SWITCHING CHARACTERISTICS (2.4V-3.6V)

Symbol	Parameter	Test Condition	Options	Min.	Typ.(1)	Max.	Unit
V_{DR}	V_{DD} for Data Retention	See Data Retention Waveform		2.0	—	3.6	V
I_{DR}	Data Retention Current	$V_{DD} = V_{DR}$(min), $\overline{CE} \geq V_{DD} - 0.2V$,	Com.	—	0.5	3	mA
		$V_{IN} \geq V_{DD}$- 0.2V or	Ind.	—	—	4	
		$V_{IN} \leq 0.2V$	Auto.			10	
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 $V_{DD} = V_{DR}$(min), $T_A = 25^oC$ and not 100% tested.

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



ORDERING INFORMATION (HIGH SPEED)

Industrial Range: -40°C to +85°C

Speed (ns)	Order Part No.	Package
8	IS61WV6416EEBLL-8BLI	48 mini BGA (6mm x 8mm), Lead-free
	IS61WV6416EEBLL-8TLI	TSOP (Type II), Lead-free
10	IS61WV6416EEBLL-10BLI	48 mini BGA (6mm x 8mm), Lead-free
	IS61WV6416EEBLL-10TLI	TSOP (Type II), Lead-free

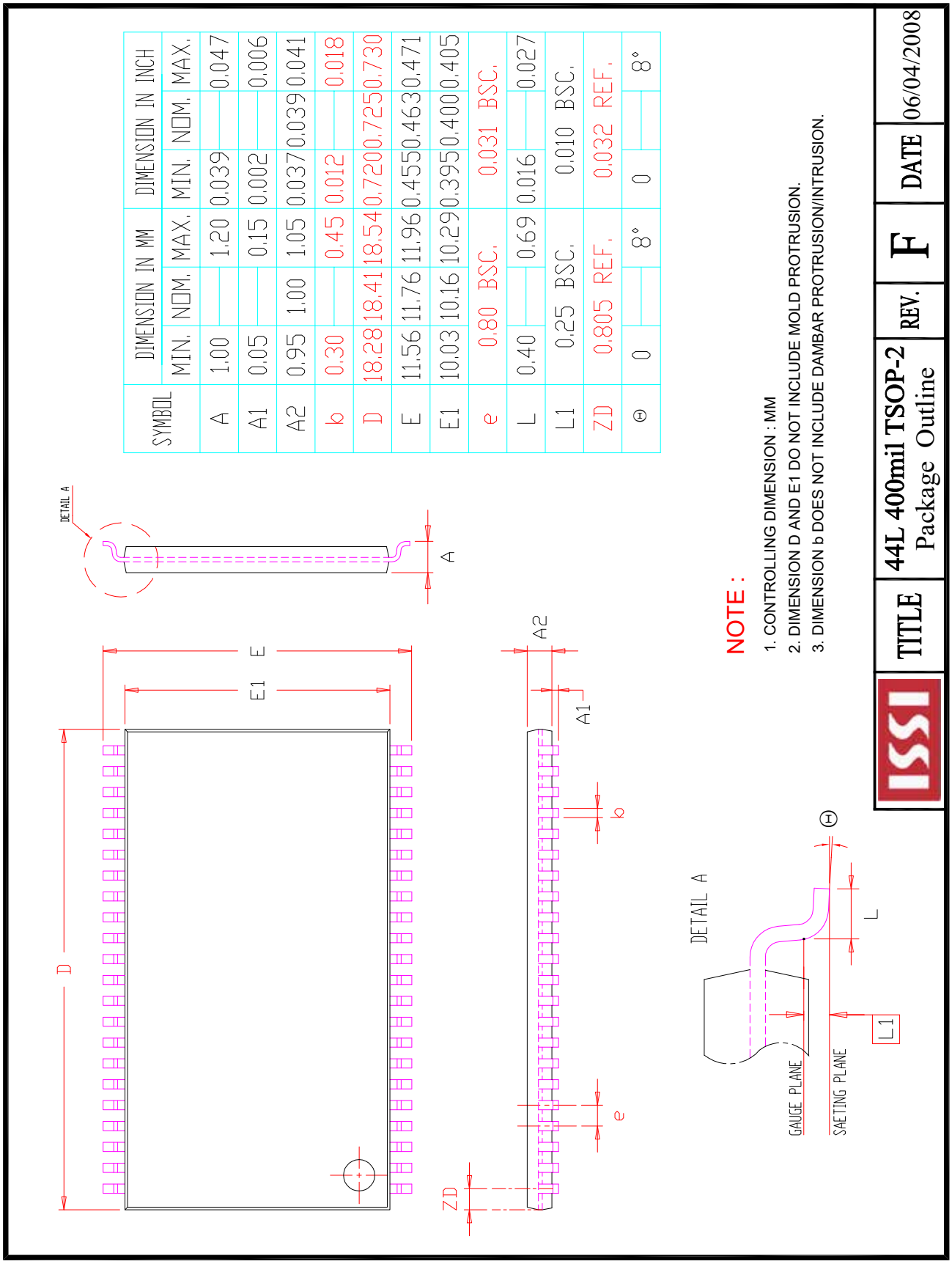
Automotive A1 Range: -40°C to +85°C

Speed (ns)	Order Part No.	Package
8	IS64WV6416EEBLL-8BLA1	48 mini BGA (6mm x 8mm), Lead-free
	IS64WV6416EEBLL-8CTLA1	TSOP (Type II), Lead-free, Copper Leadframe
10	IS64WV6416EEBLL-10BLA1	48 mini BGA (6mm x 8mm), Lead-free
	IS64WV6416EEBLL-10CTLA1	TSOP (Type II), Lead-free, Copper Leadframe

Automotive A3 Range: -40°C to +125°C

Speed (ns)	Order Part No.	Package
10	IS64WV6416EEBLL-10BLA3	48 mini BGA (6mm x 8mm), Lead-free
	IS64WV6416EEBLL-10CTLA3	TSOP (Type II), Lead-free, Copper Leadframe

SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.00	—	1.20	0.039	—	0.047
A1	0.05	—	0.15	0.002	—	0.006
A2	0.95	1.00	1.05	0.037	0.039	0.041
b	0.30	—	0.45	0.012	—	0.018
D	18.28	18.41	18.54	0.720	0.725	0.730
E	11.56	11.76	11.96	0.455	0.463	0.471
E1	10.03	10.16	10.29	0.395	0.400	0.405
e	0.80 BSC.			0.031 BSC.		
L	0.40	—	0.69	0.016	—	0.027
L1	0.25 BSC.			0.010 BSC.		
ZD	0.805 REF.			0.032 REF.		
Θ	0	—	8°	0	—	8°



NOTE :

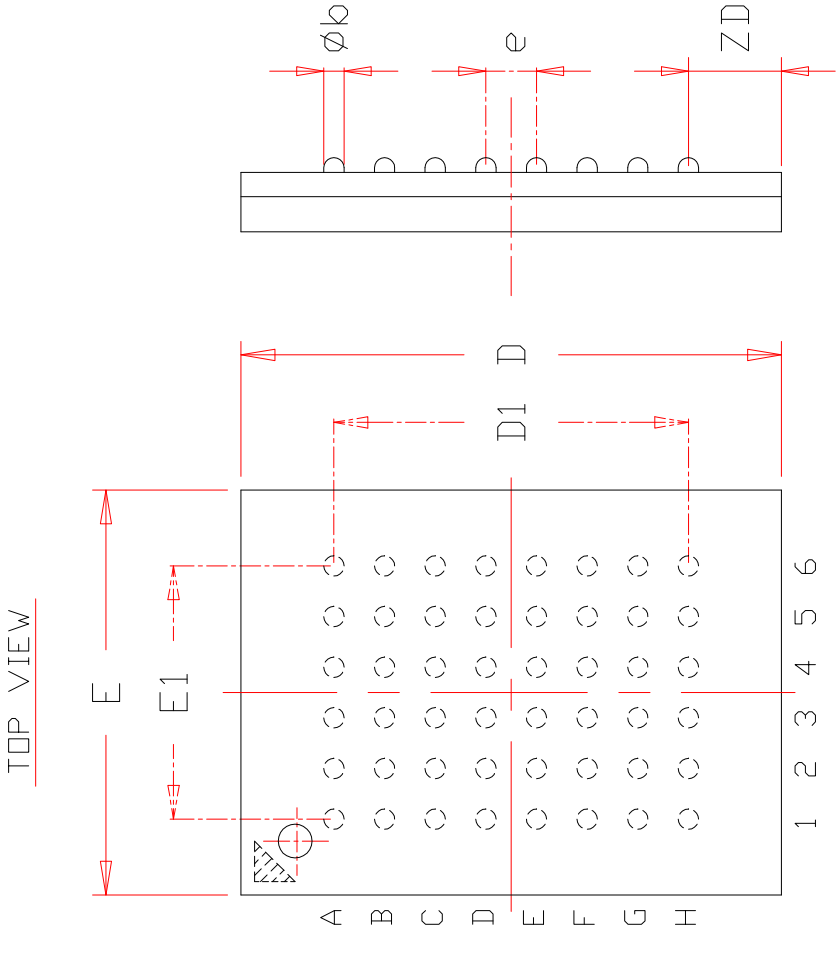
1. CONTROLLING DIMENSION : MM
2. DIMENSION D AND E1 DO NOT INCLUDE MOLD PROTRUSION.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION/INTRUSION.

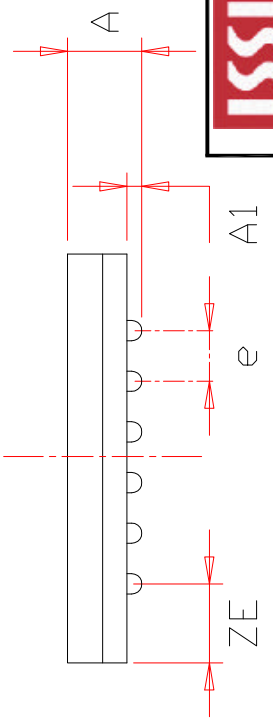
TITLE	44L 400mil TSOP-2 Package Outline	REV.	F	DATE	06/04/2008

SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A			1.20			0.047
A1	0.20		0.30	0.008		0.012
ϕb	0.30	0.35	0.40	0.012	0.014	0.016
D	7.90	8.00	8.10	0.311	0.315	0.319
D1		5.25 BSC			0.207 BSC	
E	5.90	6.00	6.10	0.232	0.236	0.240
E1		3.75 BSC			0.148 BSC	
e		0.75 BSC.			0.030 BSC.	
ZD		1.375 REF.			0.054 REF.	
ZE		1.125 REF.			0.044 REF.	

NOTE :

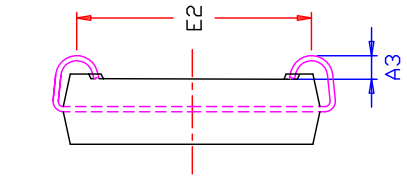
1. CONTROLLING DIMENSION : MM .
2. Reference document : JEDEC MO-207

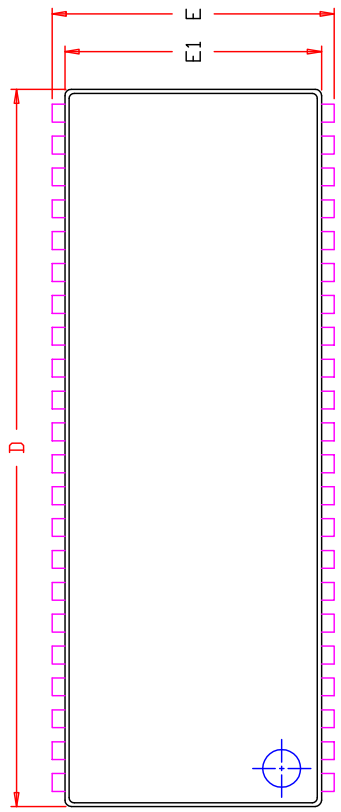




ISSI	TITLE	48L 6x8mm TF-BGA Package Outline	REV.	C	DATE	08/12/2008

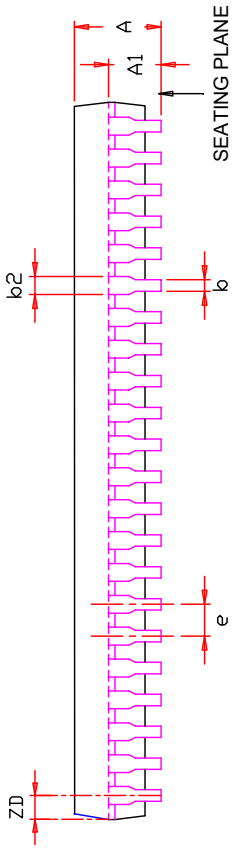
SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	3.25	—	3.76	0.128	—	0.148
A1	2.08	—	—	0.082	—	—
A3	0.635	—	—	0.025	—	—
b	0.38	—	0.51	0.015	—	0.020
b2	0.66	0.71	0.81	0.026	0.028	0.032
D	28.45	28.58	28.70	1.120	1.125	1.130
E	11.05	11.18	11.30	0.435	0.440	0.445
E1	10.03	10.16	10.29	0.395	0.400	0.405
E2	9.40 BSC.			0.370 BSC.		
e	1.27 BSC.			0.050 BSC.		
ZD	0.95 REF.			0.037 REF.		





NOTE :

1. Controlling dimension : mm
2. Dimension D and E1 do not include mold protrusion .
3. Dimension b2 does not include dambar protrusion/intrusion.
4. Formed leads shall be planar with respect to one another within 0.1mm at the seating plane after final test.
5. Reference document : JEDEC SPEC MS-027.



ISSI	TITLE	44L 400mil SOJ Package Outline	REV. E	DATE 12/21/2007