128K x 8 HIGH-SPEED CMOS STATIC RAM

MAY 2006

FEATURES

- High-speed access time:
  12 ns: 3.3V ± 10%
  15 ns: 2.5V – 3.6V
- High-performance, low-power CMOS process
- CMOS Low Power Operation
  50 mW (typical) operating current
  25 µW (typical) standby current
- Multiple center power and ground pins for greater noise immunity
- Easy memory expansion with $\overline{CE}$ and $\overline{OE}$ options
- $\overline{CE}$ power-down
- Fully static operation: no clock or refresh required
- TTL compatible inputs and outputs
- Packages available:
  – 32-pin TSOP (Type II)
  – 32-pin sTSOP (Type I)
  – 48-Ball miniBGA (6mm x 8mm)
  – 32-pin 300-mil SOJ
- Lead-free available

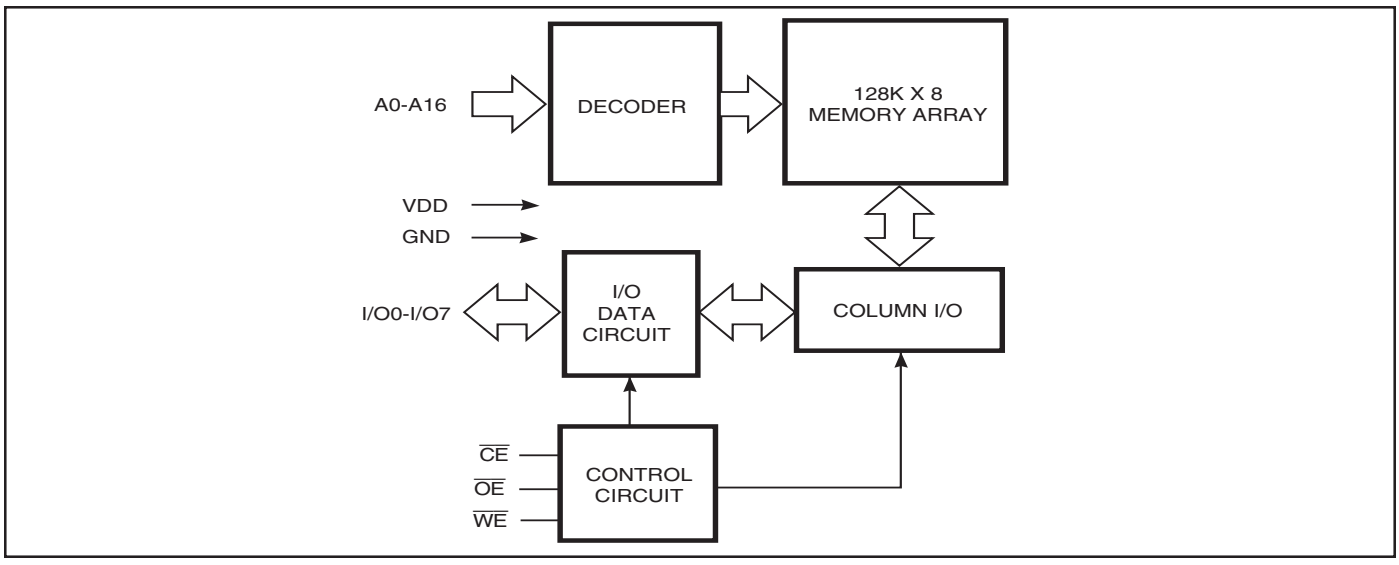
DESCRIPTION

The *ISSI* IS63/64WV1024BLL is a very high-speed, low power, 131,072-word by 8-bit CMOS static RAM. The IS63/64WV1024BLL is fabricated using *ISSI*'s high-performance CMOS technology. This highly reliable process coupled with innovative circuit design techniques, yields higher performance and low power consumption devices.

When $\overline{CE}$ is HIGH (deselected), the device assumes a standby mode at which the power dissipation can be reduced down to 25 µW (typical) with CMOS input levels.

The IS63/64WV1024BLL operates from a single V_{DD} power supply. The IS63/64WV1024BLL is available in 32-pin TSOP (Type II), 32-pin sTSOP (Type I), 48-Ball miniBGA (6mm x 8mm), and 32-pin SOJ (300-mil) packages.

FUNCTIONAL BLOCK DIAGRAM



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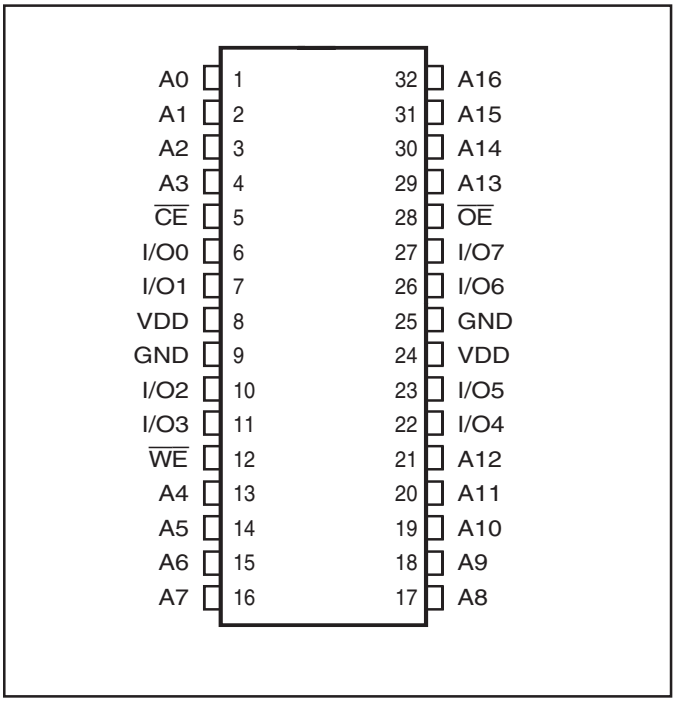
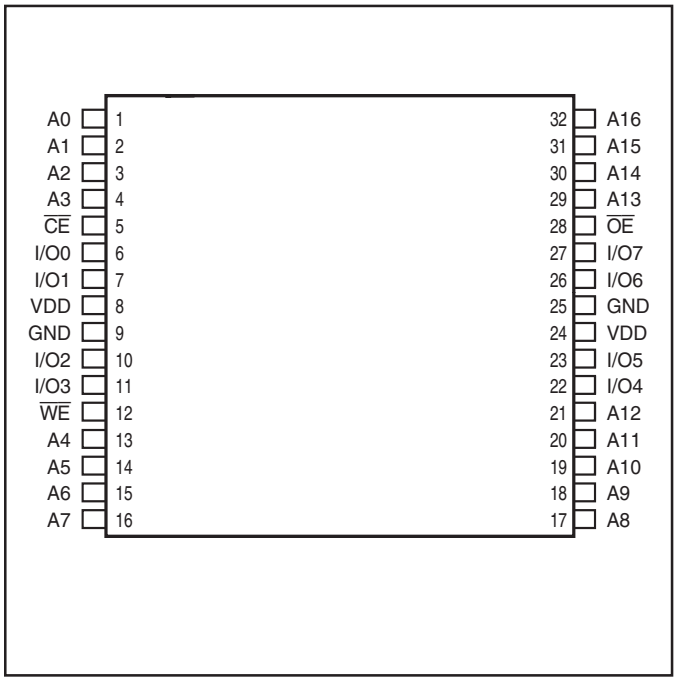
PIN CONFIGURATION
32-Pin SOJ



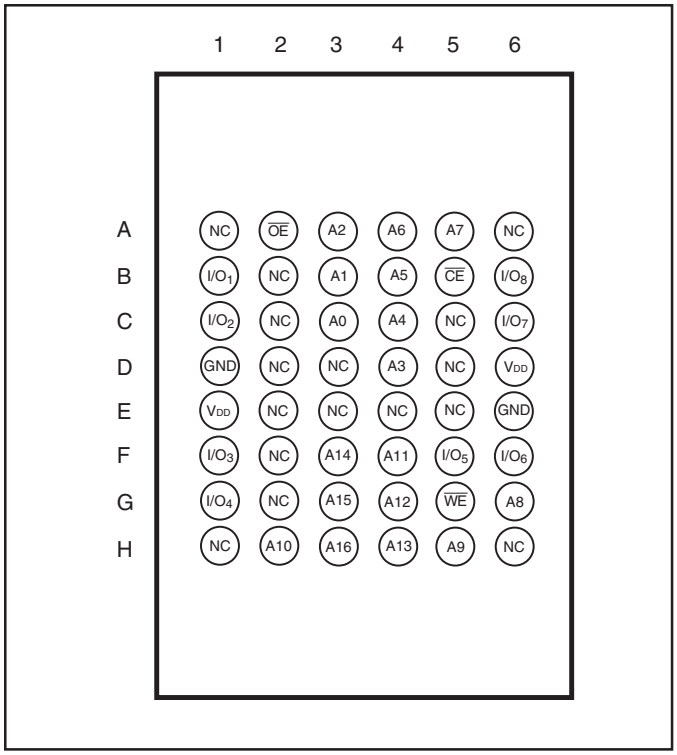
PIN CONFIGURATION
32-Pin TSOP (Type II) (T)
32-Pin sTSOP (Type I) (H)



PIN DESCRIPTIONS

A0-A16	Address Inputs
$\overline{CE}$	Chip Enable Input
$\overline{OE}$	Output Enable Input
$\overline{WE}$	Write Enable Input
I/O0-I/O7	Bidirectional Ports
V_{DD}	Power
GND	Ground

PIN CONFIGURATION
48-mini BGA (B) (6 mm x 8 mm)



TRUTH TABLE

Mode	$\overline{WE}$	$\overline{CE}$	$\overline{OE}$	I/O Operation	V_{DD} Current
Not Selected (Power-down)	X	H	X	High-Z	I_{SB1}, I_{SB2}
Output Disabled	H	L	H	High-Z	I_{CC1}, I_{CC2}
Read	H	L	L	D_{OUT}	I_{CC1}, I_{CC2}
Write	L	L	X	D_{IN}	I_{CC1}, I_{CC2}

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})

Range	Ambient Temperature	V_{DD} (15 ns)	V_{DD} (12 ns)
Commercial	0°C to +70°C	2.5V-3.6V	3.3V $\pm$ 10%
Industrial	–40°C to +85°C	2.5V-3.6V	3.3V $\pm$ 10%
Automotive	–40°C to +125°C	2.5V-3.6V	3.3V $\pm$ 10%

DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

V_{DD} = 2.5V-3.6V

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{DD} = Min., I_{OH} = –1.0 mA	2.3	—	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}	–2	2	µA
I_{LO}	Output Leakage	GND ≤ V_{OUT} ≤ V_{DD}, Outputs Disabled	–2	2	µA

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

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}	–2	2	µA
I_{LO}	Output Leakage	GND ≤ V_{OUT} ≤ V_{DD}, Outputs Disabled	–2	2	µA

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

POWER SUPPLY CHARACTERISTICS[1] (Over Operating Range)

Symbol	Parameter	Test Conditions	Options	-12 ns Min.	-12 ns Max.	-15 ns Min.	-15 ns Max.	Unit
I_{CC}	V_{DD} Dynamic Operating Supply Current	V_{DD} = Max., I_{OUT} = 0 mA, f = f_{MAX}	COM.	—	35	—	30	mA
			IND.	—	45	—	40	
			AUTO	—	60	—	50	
			typ.[2]	—	20	—	20	
I_{CC1}	Operating Supply Current	V_{DD} = Max., Iout = 0mA, f = 0	COM.	—	5	—	5	mA
			IND.	—	5	—	5	
			AUTO	—	5	—	5	
I_{SB1}	TTL Standby Current (TTL Inputs)	V_{DD} = Max., V_{IN} = V_{IH} or V_{IL} $\overline{CE} \geq V_{IH}$, f = 0	COM.	—	3	—	3	mA
			IND.	—	4	—	4	
			AUTO	—	4	—	4	
I_{SB2}	CMOS Standby Current (CMOS Inputs)	V_{DD} = Max., $\overline{CE} \geq V_{DD} - 0.2V$, $V_{IN} \geq V_{DD} - 0.2V$, or $V_{IN} \leq 0.2V$, f = 0	COM.	—	20	—	20	uA
			IND.	—	50	—	50	
			AUTO	—	75	—	75	
			typ.[2]	—	6	—	6	

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 (2.5V-3.6V)	Unit (3.3V ± 10%)
Input Pulse Level	0V to V_{DD} V	0V to V_{DD} V
Input Rise and Fall Times	1.5ns	1.5ns
Input and Output Timing and Reference Level (V_{Ref})	$V_{DD}/2$	$V_{DD}/2 + 0.05$
Output Load	See Figures 1a and 1b	See Figures 1a and 1b

AC TEST LOADS

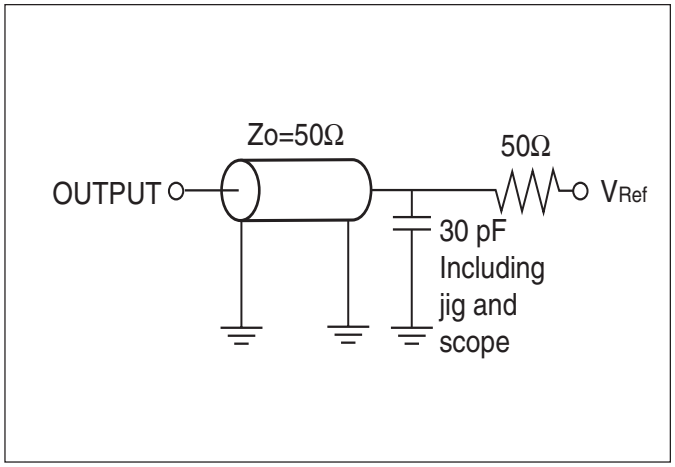


Figure 1a.

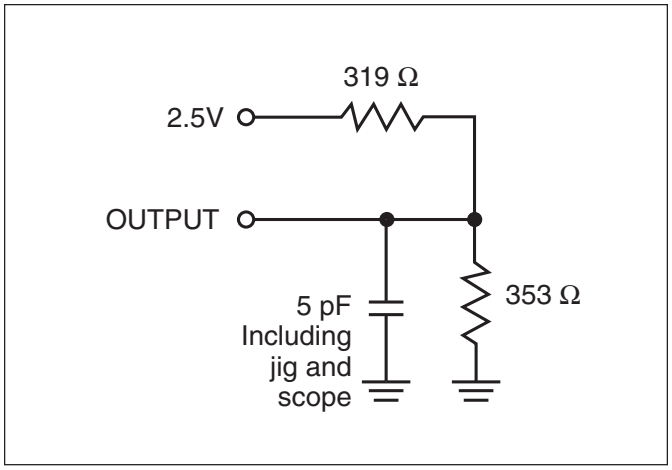


Figure 1b.

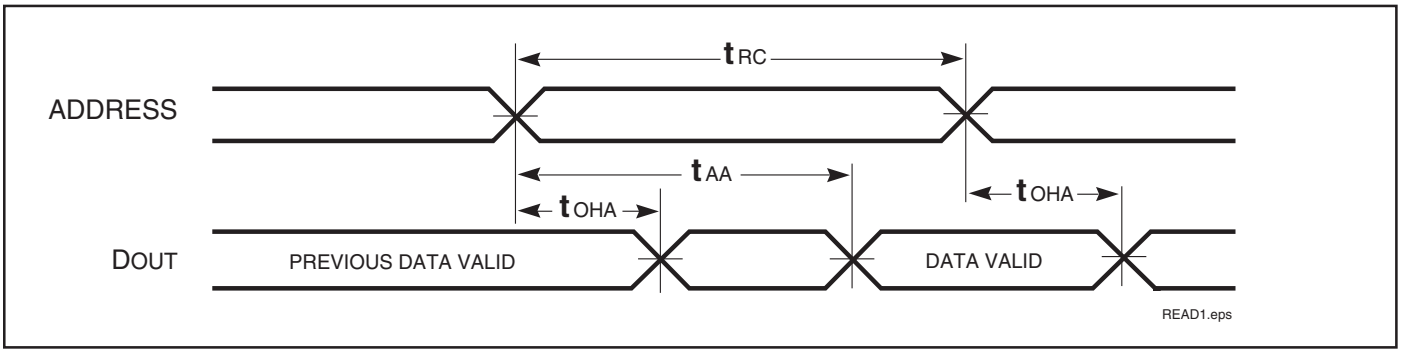
READ CYCLE SWITCHING CHARACTERISTICS[1] (Over Operating Range)

Symbol	Parameter	-12 ns Min.	-12 ns Max.	-15 ns Min.	-15 ns Max.	Unit
t_{RC}	Read Cycle Time	12	—	15	—	ns
t_{AA}	Address Access Time	—	12	—	15	ns
t_{OHA}	Output Hold Time	3	—	3	—	ns
t_{ACE}	$\overline{CE}$ Access Time	—	12	—	15	ns
t_{DOE}	$\overline{OE}$ Access Time	—	6	—	7	ns
t_{LZOE}[2]	$\overline{OE}$ to Low-Z Output	0	—	0	—	ns
t_{HZOE}[2]	$\overline{OE}$ to High-Z Output	0	6	0	6	ns
t_{LZCE}[2]	$\overline{CE}$ to Low-Z Output	3	—	3	—	ns
t_{HZCE}[2]	$\overline{CE}$ to High-Z Output	0	6	0	6	ns
t_{PU}	$\overline{CE}$ to Power Up Time	0	—	0	—	ns
t_{PD}	$\overline{CE}$ to Power Down Time	—	12	—	15	ns

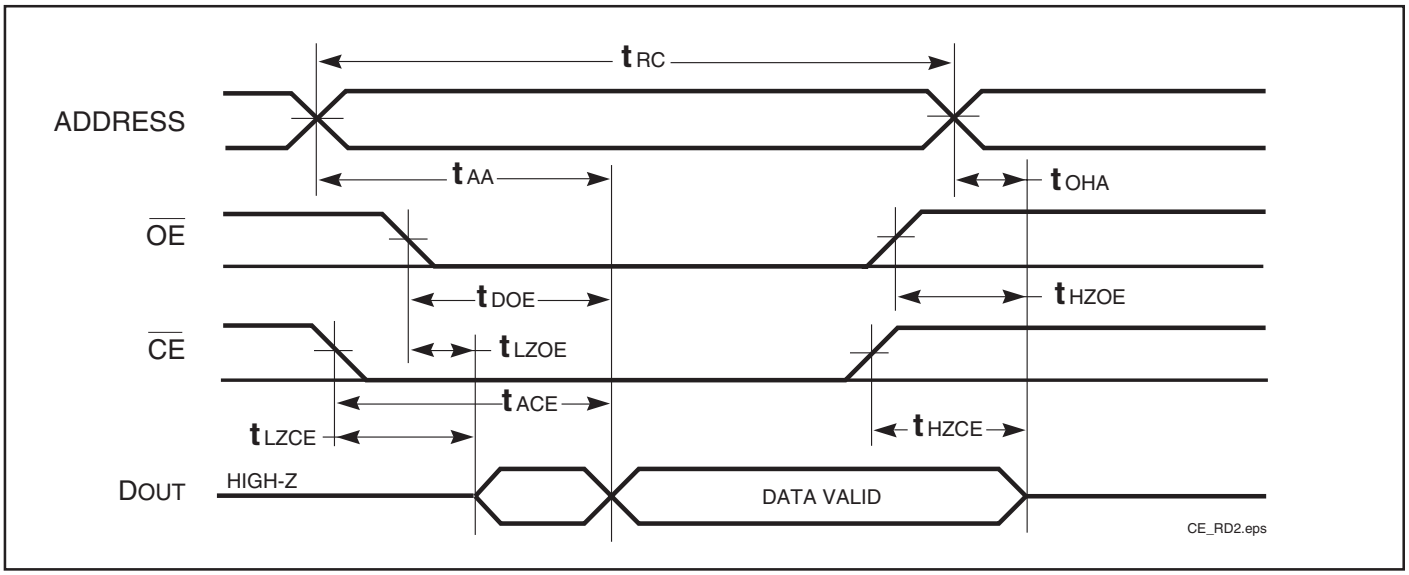
Notes:
1. Test conditions assume signal transition times of 3 ns or less, timing reference levels of 1.25V, input pulse levels of 0.4V to V_{DD}-0.3V and output loading specified in Figure 1.
2. Tested with the loading specified in Figure 1. Transition is measured ±500 mV from steady-state voltage. Not 100% tested.

AC WAVEFORMS

READ CYCLE NO. 1[1,2]



READ CYCLE NO. 2[1,3]



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

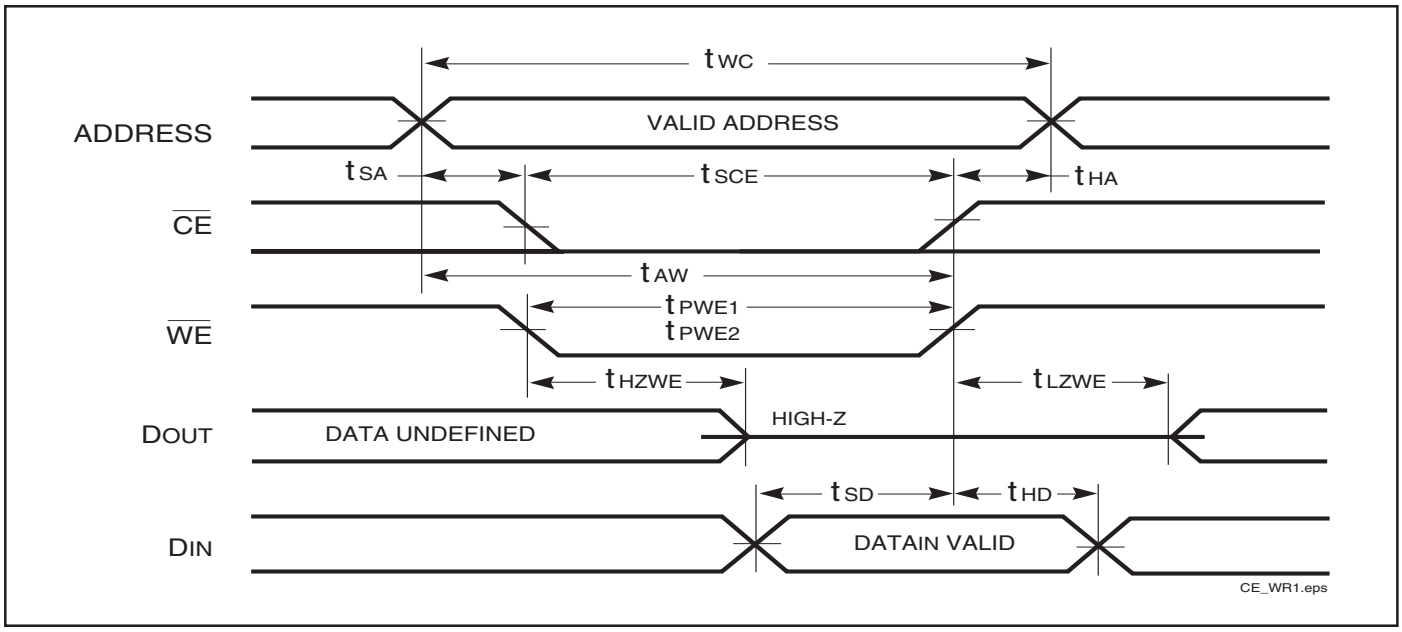
WRITE CYCLE SWITCHING CHARACTERISTICS[1,3] (Over Operating Range)

Symbol	Parameter	-12 ns Min.	-12 ns Max.	-15 ns Min.	-15 ns Max.	Unit
t_{WC}	Write Cycle Time	12	—	15	—	ns
t_{SCE}	$\overline{CE}$ to Write End	9	—	10	—	ns
t_{AW}	Address Setup Time to Write End	9	—	10	—	ns
t_{HA}	Address Hold from Write End	0	—	0	—	ns
t_{SA}	Address Setup Time	0	—	0	—	ns
t_{PWE_1}[1]	$\overline{WE}$ Pulse Width ($\overline{OE}$ High)	9	—	10	—	ns
t_{PWE_2}[2]	$\overline{WE}$ Pulse Width ($\overline{OE}$ Low)	11	—	12	—	ns
t_{SD}	Data Setup to Write End	9	—	9	—	ns
t_{HD}	Data Hold from Write End	0	—	0	—	ns
t_{HZWE}[2]	$\overline{WE}$ LOW to High-Z Output	—	6	—	7	ns
t_{LZWE}[2]	$\overline{WE}$ HIGH to Low-Z Output	3	—	3	—	ns

Notes:
1. Test conditions assume signal transition times of 3ns or less, timing reference levels of 1.25V, input pulse levels of 0.4V to V_{DD}-0.3V and output loading specified in Figure 1a.
2. Tested with the loading specified 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 $\overline{WE}$ 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.

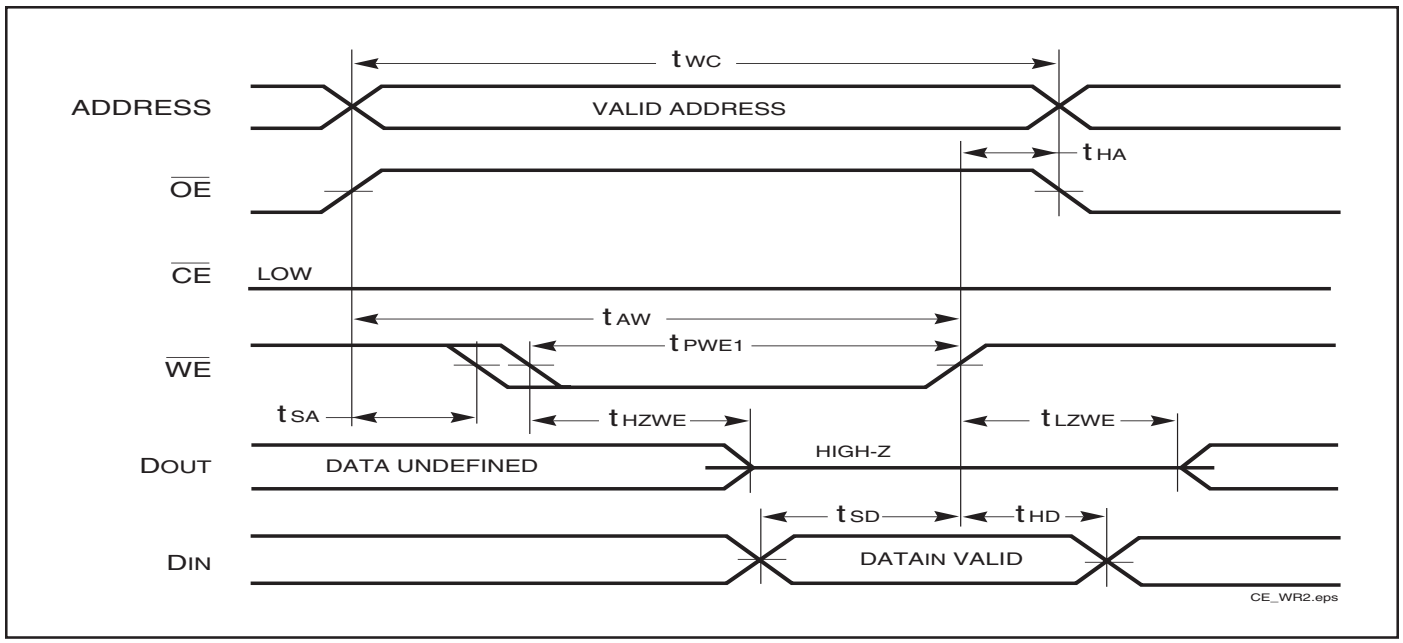
AC WAVEFORMS

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

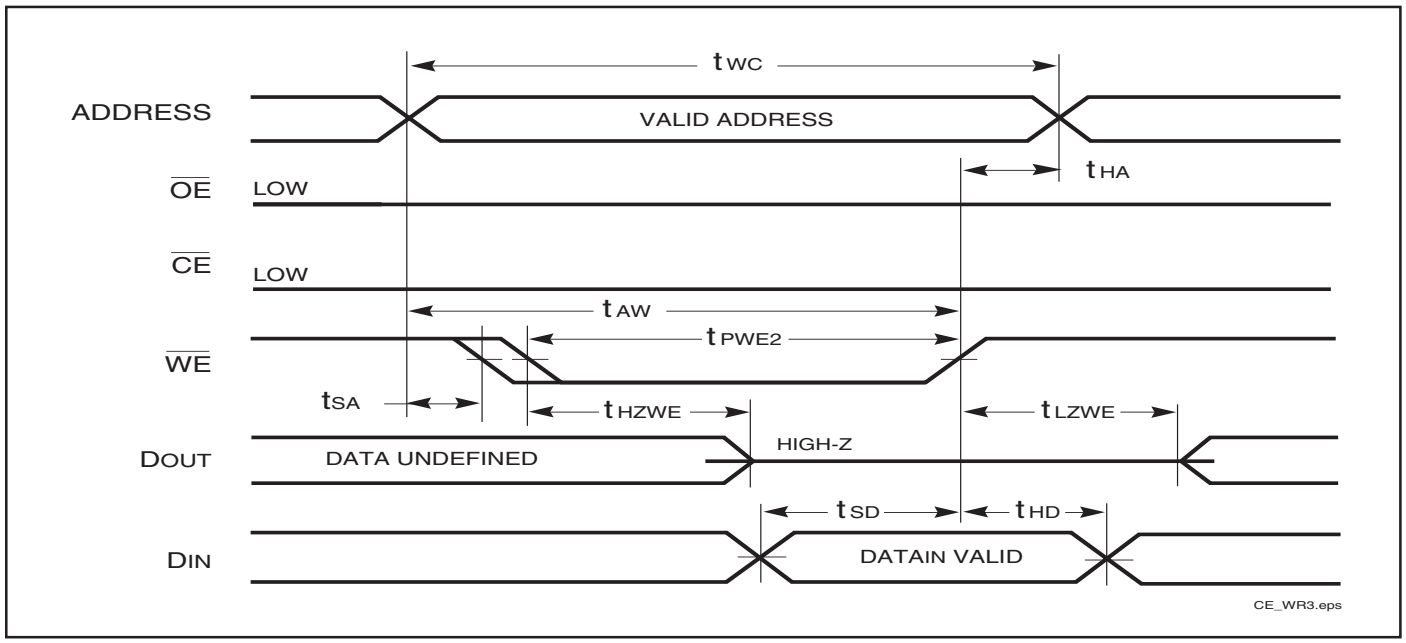


AC WAVEFORMS

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)



Notes:

1. The internal write time is defined by the overlap of $\overline{CE}$ LOW 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.
2. I/O will assume the High-Z state if $\overline{OE}$ > V_{IH}.

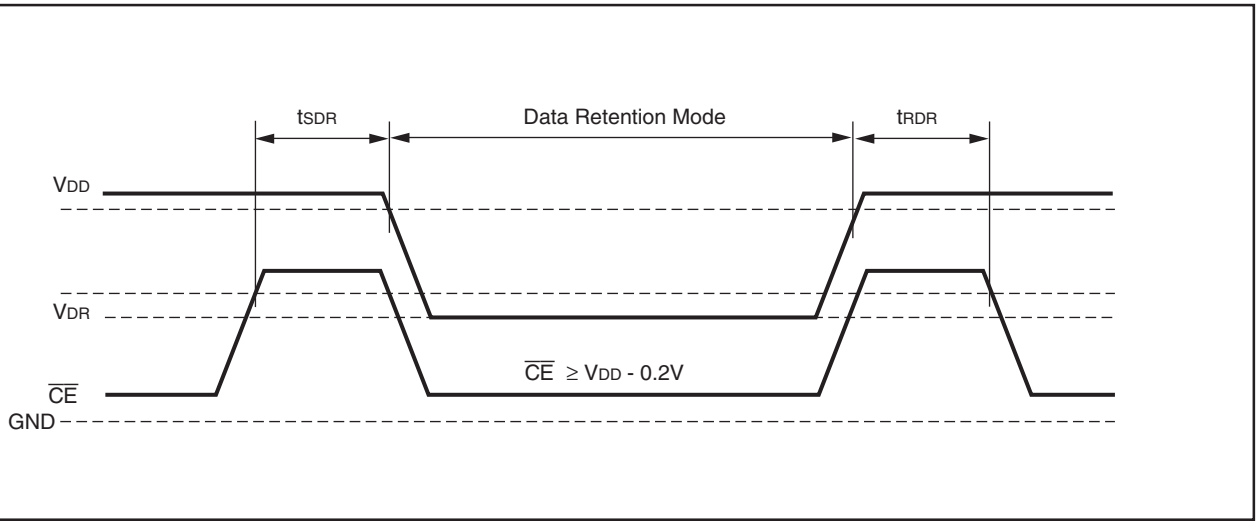
DATA RETENTION SWITCHING CHARACTERISTICS

Symbol	Parameter	Test Condition	Operations	Min.	Typ.(1)	Max.	Unit
V_{DR}	V_{DD} for Data Retention	See Data Retention Waveform		1.8	—	3.6	V
I_{DR}	Data Retention Current	V_{DD} = 1.8V, $\overline{CE} \geq V_{DD} - 0.2V$	COM.	—	6	20	µA
			IND.	—	6	50	
			AUTO.	—	6	75	
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

Industrial Range: –40°C to +85°C

Speed (ns)	Order Part No.	Package
12	IS63WV1024BLL-12TI	32-pin TSOP (Type II)
	IS63WV1024BLL-12TLI	32-pin TSOP (Type II), Lead-free
	IS63WV1024BLL-12HI	sTSOP (Type I) (8mm x13.4mm)
	IS63WV1024BLL-12HLI	sTSOP (Type I) (8mm x13.4mm), Lead-free
	IS63WV1024BLL-12JI	32-pin SOJ (300-mil)
	IS63WV1024BLL-12JLI	32-pin SOJ (300-mil), Lead-free
	IS63WV1024BLL-12BI	mBGA(6mmx8mm)
	IS63WV1024BLL-12BLI	mBGA(6mmx8mm), Lead-free

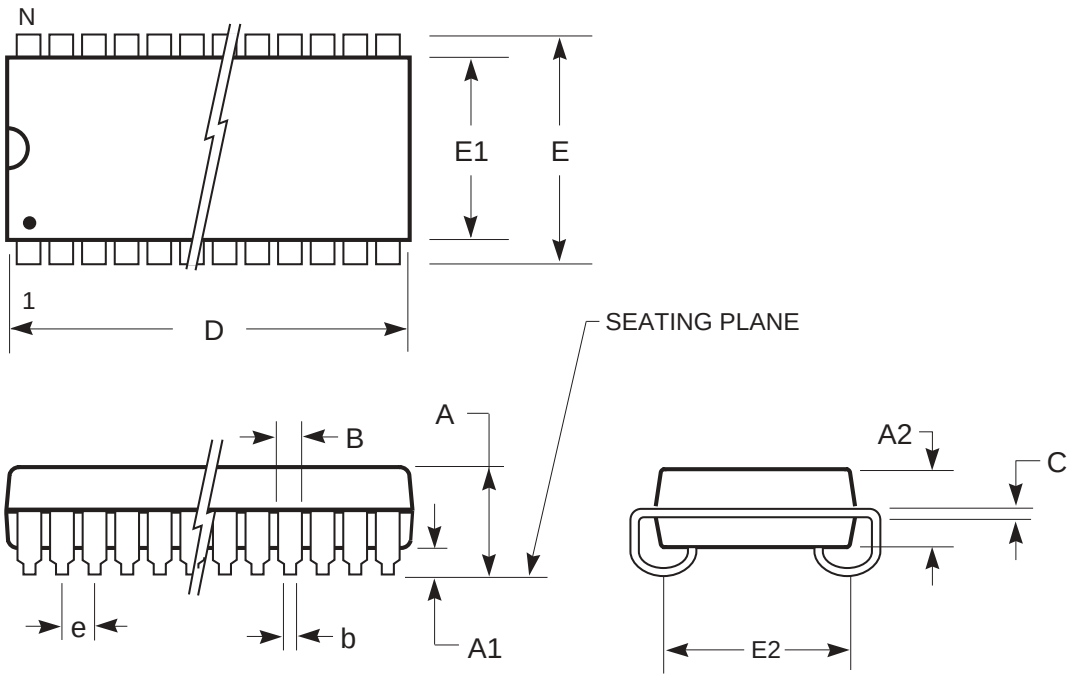
Automotive Range (A3): –40°C to +85°C

Speed (ns)	Order Part No.	Package
15 (12*)	IS64WV1024BLL-15TA3	32-pin TSOP (Type II)
	IS64WV1024BLL-15TLA3	32-pin TSOP (Type II), Lead-free
	IS64WV1024BLL-15HA3	sTSOP (Type I) (8mm x13.4mm)
	IS64WV1024BLL-15HLA3	sTSOP (Type I) (8mm x13.4mm), Lead-free
	IS64WV1024BLL-15BA3	mBGA(6mmx8mm)
	IS64WV1024BLL-15BLA3	mBGA(6mmx8mm), Lead-free

Note:
1. Speed = 12ns for V_{DD} = 3.3V $\pm$ 10%. Speed = 15ns for V_{DD} = 2.5V-3.6V.

PACKAGING INFORMATION

300-mil Plastic SOJ
Package Code: J



	MILLIMETERS			INCHES		
Sym.	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
N0. Leads		**24/26**				
A	—	—	3.56	—	—	0.140
A1	0.64	—	—	0.025	—	—
A2	2.41	—	2.67	0.095	—	0.105
b	0.41	—	0.51	0.016	—	0.020
B	0.66	—	0.81	0.026	—	0.032
C	0.20	—	0.25	0.008	—	0.010
D	17.02	—	17.27	0.670	—	0.680
E	8.26	—	8.76	0.325	—	0.345
E1	7.49	—	7.75	0.295	—	0.305
E2	6.27	—	7.29	0.247	—	0.287
e	1.27 BSC			0.050 BSC		

Notes:
1. Controlling dimension: inches, 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.

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PACKAGING INFORMATION

ISSI®

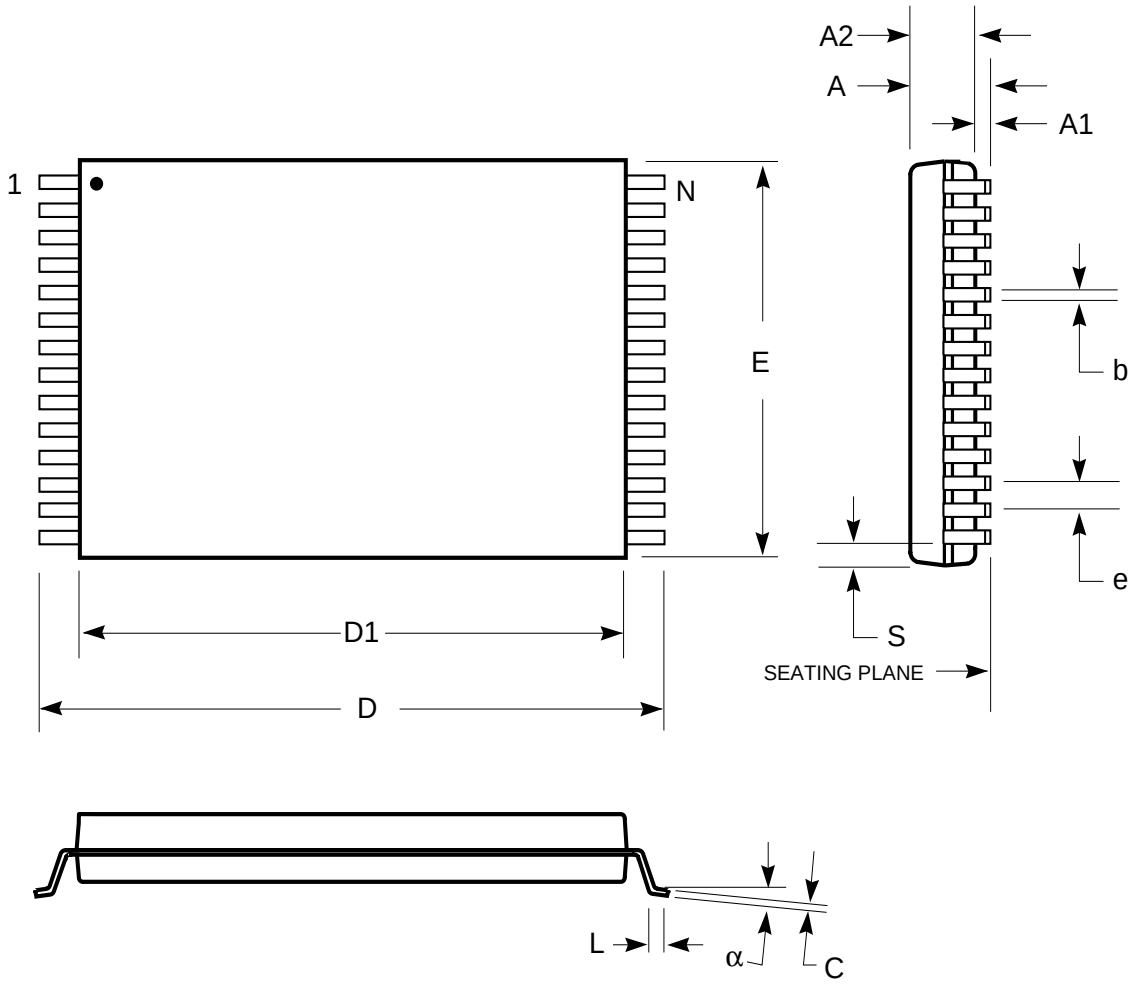
300-mil Plastic SOJ
Package Code: J

	MILLIMETERS			INCHES		
Sym.	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
N0. Leads		**28**				
A	—	—	3.56	—	—	0.140
A1	0.64	—	—	0.025	—	—
A2	2.41	—	2.67	0.095	—	0.105
b	0.41	—	0.51	0.016	—	0.020
B	0.66	—	0.81	0.026	—	0.032
C	0.20	—	0.25	0.008	—	0.010
D	18.29	—	18.54	0.720	—	0.730
E	8.26	—	8.76	0.325	—	0.345
E1	7.49	—	7.75	0.295	—	0.305
E2	6.27	—	7.29	0.247	—	0.287
e	1.27 BSC			0.050 BSC		

	MILLIMETERS			INCHES		
Sym.	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
N0. Leads		**32**				
A	—	—	3.56	—	—	0.140
A1	0.64	—	—	0.025	—	—
A2	2.41	—	2.67	0.095	—	0.105
b	0.41	—	0.51	0.016	—	0.020
B	0.66	—	0.81	0.026	—	0.032
C	0.20	—	0.25	0.008	—	0.010
D	20.83	—	21.08	0.820	—	0.830
E	8.26	—	8.76	0.325	—	0.345
E1	7.49	—	7.75	0.295	—	0.305
E2	6.27	—	7.29	0.247	—	0.287
e	1.27 BSC			0.050 BSC		

PACKAGING INFORMATION

Plastic STSOP - 32 pins
Package Code: H (Type I)

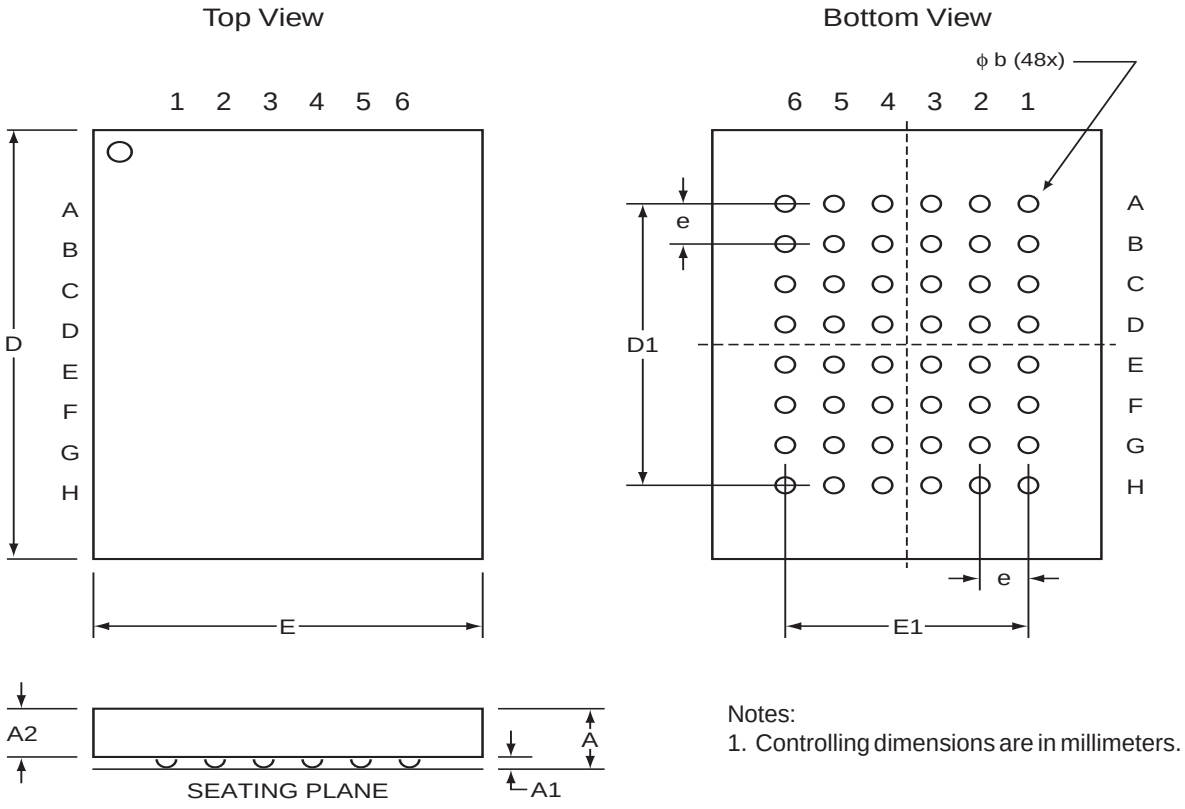


Plastic STSOP (H - Type I)				
	Millimeters		Inches	
Symbol	Min	Max	Min	Max
Ref. Std.				
N		32		
A	—	1.25	—	0.049
A1	0.05	—	0.002	—
A2	0.95	1.05	0.037	0.041
b	0.17	0.23	0.007	0.009
C	0.14	0.16	0.0055	0.0063
D	13.20	13.60	0.520	0.535
D1	11.70	11.90	0.461	0.469
E	7.90	8.10	0.311	0.319
e	0.50 BSC		0.020 BSC	
L	0.30	0.70	0.012	0.028
S	0.28 Typ.		0.011 Typ.	
α	0°	5°	0°	5°

Notes:
1. Controlling dimension: millimeters, unless otherwise specified.
2. BSC = Basic lead spacing between centers.
3. Dimensions D1 and E 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.

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

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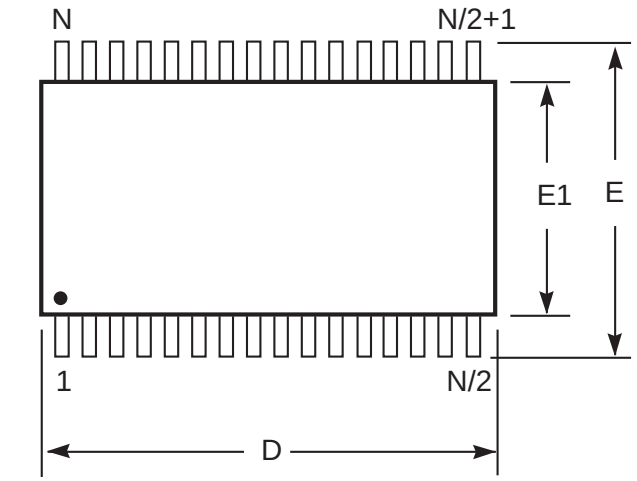
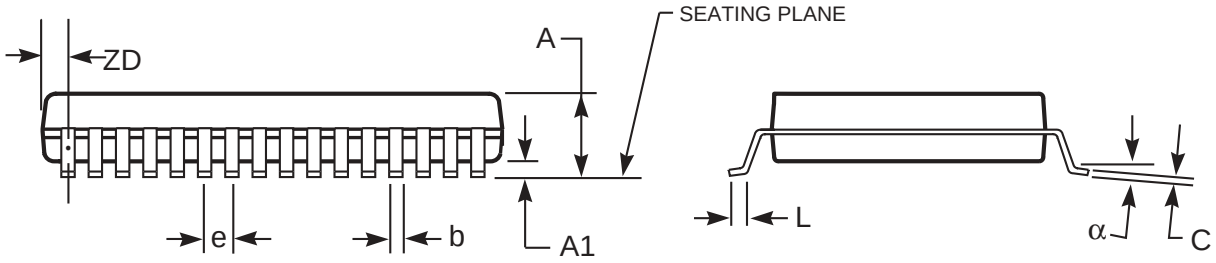
PACKAGING INFORMATION

ISSI®

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°

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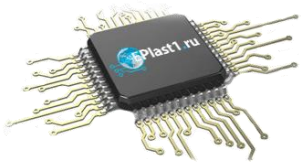
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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