

# 1M x 16 HIGH-SPEED LOW POWER ASYNCHRONOUS CMOS STATIC RAM

JANUARY 2008

## FEATURES

- High-speed access times:  
25, 35 ns
- High-performance, low-power CMOS process
- Multiple center power and ground pins for greater noise immunity
- Easy memory expansion with  $\overline{\text{CS1}}$  and  $\overline{\text{OE}}$  options
- $\overline{\text{CS1}}$  power-down
- Fully static operation: no clock or refresh required
- TTL compatible inputs and outputs
- Single power supply  
 $V_{\text{DD}}$  1.65V to 2.2V (IS62WV102416ALL)  
 speed = 35ns for  $V_{\text{DD}}$  1.65V to 2.2V  
 $V_{\text{DD}}$  2.4V to 3.6V (IS62/65WV102416BLL)  
 speed = 25ns for  $V_{\text{DD}}$  2.4V to 3.6V
- Packages available:
  - 48-ball miniBGA (9mm x 11mm)
  - 48-pin TSOP (Type I)
- Industrial and Automotive Temperature Support
- Lead-free available
- Data control for upper and lower bytes

## DESCRIPTION

The *ISSI* IS62WV102416ALL/BLL and IS65WV102416BLL are high-speed, 16M-bit static RAMs organized as 1024K 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 high-performance and low power consumption devices.

When  $\overline{\text{CS1}}$  is HIGH (deselected) or when CS2 is LOW (deselected) or when  $\overline{\text{CS1}}$  is LOW, CS2 is HIGH and both  $\overline{\text{LB}}$  and  $\overline{\text{UB}}$  are HIGH, 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. The active LOW Write Enable ( $\overline{\text{WE}}$ ) controls both writing and reading of the memory. A data byte allows Upper Byte ( $\overline{\text{UB}}$ ) and Lower Byte ( $\overline{\text{LB}}$ ) access.

The device is packaged in the JEDEC standard 48-pin TSOP Type I and 48-pin Mini BGA (9mm x 11mm).

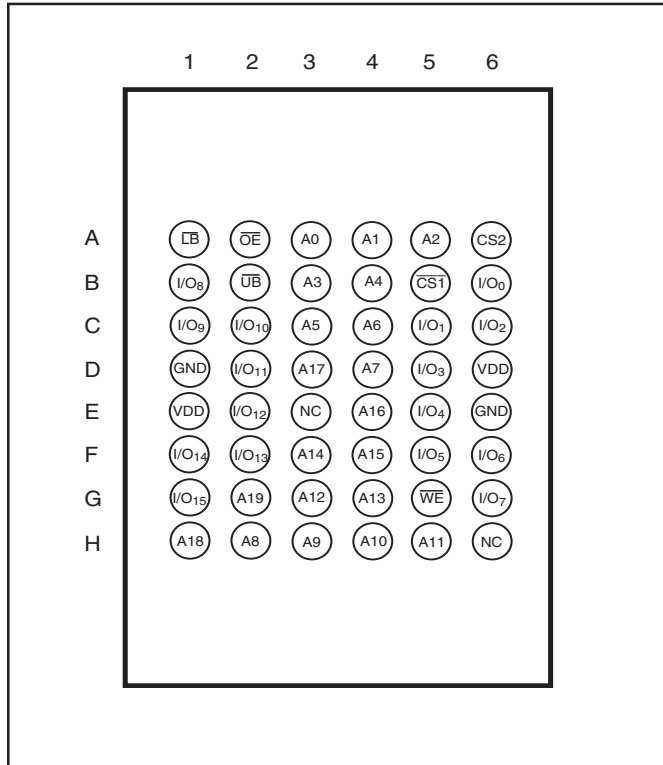
## FUNCTIONAL BLOCK DIAGRAM



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## 1Mx16 LOW POWER PIN CONFIGURATIONS

### 48-Pin mini BGA (9mmx11mm)



### PIN DESCRIPTIONS

A0-A19	Address Inputs
I/O0-I/O15	Data Inputs/Outputs
$\overline{CS1}$ , CS2	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 <sub>DD</sub>	Power
GND	Ground

48-pin TSOP-I (12mm x 20mm)



**PIN DESCRIPTIONS**

A0-A19	Address Inputs
I/O0-I/O15	Data Inputs/Outputs
CS1	Chip Enable Input
OE	Output Enable Input
WE	Write Enable Input
LB	Lower-byte Control (I/O0-I/O7)
UB	Upper-byte Control (I/O8-I/O15)
NC	No Connection
VDD	Power
GND	Ground

## TRUTH TABLE

Mode	$\overline{WE}$	$\overline{CS1}$	CS2	$\overline{OE}$	$\overline{LB}$	$\overline{UB}$	I/O PIN		V <sub>DD</sub> Current
							I/O0-I/O7	I/O8-I/O15	
Not Selected	X	H	X	X	X	X	High-Z	High-Z	ISB1, ISB2
	X	X	L	X	X	X	High-Z	High-Z	ISB1, ISB2
	X	X	X	X	H	H	High-Z	High-Z	ISB1, ISB2
Output Disabled	H	L	H	H	L	X	High-Z	High-Z	I <sub>CC</sub>
	H	L	H	H	X	L	High-Z	High-Z	I <sub>CC</sub>
Read	H	L	H	L	L	H	DOUT	High-Z	I <sub>CC</sub>
	H	L	H	L	H	L	High-Z	DOUT	
	H	L	H	L	L	L	DOUT	DOUT	
Write	L	L	H	X	L	H	DIN	High-Z	I <sub>CC</sub>
	L	L	H	X	H	L	High-Z	DIN	
	L	L	H	X	L	L	DIN	DIN	

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Symbol	Parameter	Value	Unit
V <sub>TERM</sub>	Terminal Voltage with Respect to GND	-0.5 to V <sub>DD</sub> + 0.5	V
V <sub>DD</sub>	V <sub>DD</sub> Relates to GND	-0.3 to 4.0	V
T <sub>STG</sub>	Storage Temperature	-65 to +150	°C
P <sub>T</sub>	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<sup>(1,2)</sup>

Symbol	Parameter	Conditions	Max.	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 0V	6	pF
C <sub>I/O</sub>	Input/Output Capacitance	V <sub>OUT</sub> = 0V	8	pF

### Notes:

1. Tested initially and after any design or process changes that may affect these parameters.
2. Test conditions: T<sub>A</sub> = 25°C, f = 1 MHz, V<sub>DD</sub> = 3.3V.

**OPERATING RANGE (V<sub>DD</sub>) (IS62WV102416ALL)**

Range	Ambient Temperature	V <sub>DD</sub> (35 ns)
Commercial	0°C to +70°C	1.65V-2.2V
Industrial	-40°C to +85°C	1.65V-2.2V
Automotive	-40°C to +125°C	1.65V-2.2V

**OPERATING RANGE (V<sub>DD</sub>) (IS62WV102416BLL)<sup>(1)</sup>**

Range	Ambient Temperature	V <sub>DD</sub> (25 ns)
Commercial	0°C to +70°C	2.4V-3.6V
Industrial	-40°C to +85°C	2.4V-3.6V

**Note:**

1. When operated in the range of 2.4V-3.6V, the device meets 10ns.

**OPERATING RANGE (V<sub>DD</sub>) (IS65WV102416BLL)**

Range	Ambient Temperature	V <sub>DD</sub> (25 ns)
Automotive	-40°C to +125°C	2.4V-3.6V

**DC ELECTRICAL CHARACTERISTICS** (Over Operating Range)

**V<sub>DD</sub> = 2.4V-3.6V**

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V <sub>OH</sub>	Output HIGH Voltage	V <sub>DD</sub> = Min., I <sub>OH</sub> = -1.0 mA	1.8	—	V
V <sub>OL</sub>	Output LOW Voltage	V <sub>DD</sub> = Min., I <sub>OL</sub> = 1.0 mA	—	0.4	V
V <sub>IH</sub>	Input HIGH Voltage		2.0	V <sub>DD</sub> + 0.3	V
V <sub>IL</sub>	Input LOW Voltage <sup>(1)</sup>		-0.3	0.8	V
I <sub>LI</sub>	Input Leakage	GND ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>	-1	1	μA
I <sub>LO</sub>	Output Leakage	GND ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> , Outputs Disabled	-1	1	μA

**Note:**

1. V<sub>IL</sub>(min.) = -0.3VDC; V<sub>IL</sub>(min.) = -2.0V AC (pulse width < 10ns). Not 100% tested.  
 V<sub>IH</sub>(max.) = V<sub>DD</sub> + 0.3VDC; V<sub>IH</sub>(max.) = V<sub>DD</sub> + 2.0V AC (pulse width < 10ns). Not 100% tested.

**DC ELECTRICAL CHARACTERISTICS** (Over Operating Range)

**V<sub>DD</sub> = 1.65V-2.2V**

Symbol	Parameter	Test Conditions	V <sub>DD</sub>	Min.	Max.	Unit
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -0.1 mA	1.65-2.2V	V <sub>CC</sub> - 0.4V	—	V
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 0.1 mA	1.65-2.2V	—	0.2	V
V <sub>IH</sub>	Input HIGH Voltage		1.65-2.2V	1.4	V <sub>DD</sub> + 0.2	V
V <sub>IL</sub> <sup>(1)</sup>	Input LOW Voltage		1.65-2.2V	-0.2	0.4	V
I <sub>LI</sub>	Input Leakage	GND ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>		-1	1	μA
I <sub>LO</sub>	Output Leakage	GND ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> , Outputs Disabled		-1	1	μA

**Notes:**

1. V<sub>IL</sub>(min.) = -0.3VDC; V<sub>IL</sub>(min.) = -2.0V AC (pulse width < 10ns). Not 100% tested.  
 V<sub>IH</sub>(max.) = V<sub>DD</sub> + 0.3VDC; V<sub>IH</sub>(max.) = V<sub>DD</sub> + 2.0V AC (pulse width < 10ns). Not 100% tested.

### AC TEST CONDITIONS (HIGH SPEED)

Parameter	Unit (2.4V-3.6V)	Unit (1.65V-2.2V)
Input Pulse Level	0.4V to $V_{DD}-0.3V$	0.4V to $V_{DD}-0.2V$
Input Rise and Fall Times	1.5ns	1.5ns
Input and Output Timing and Reference Level ( $V_{Ref}$ )	$V_{DD}/2$	$V_{DD}/2$
Output Load	See Figures 1 and 2	See Figures 1 and 2

### AC TEST LOADS

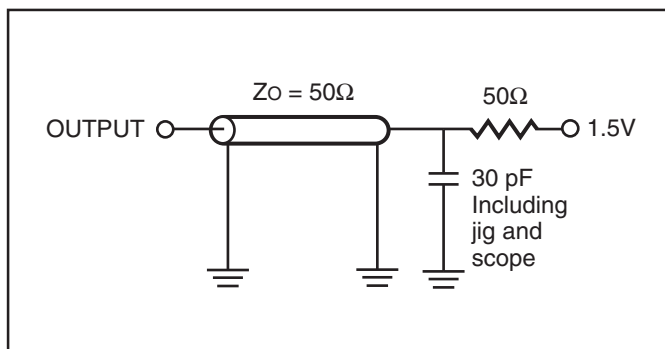


Figure 1.

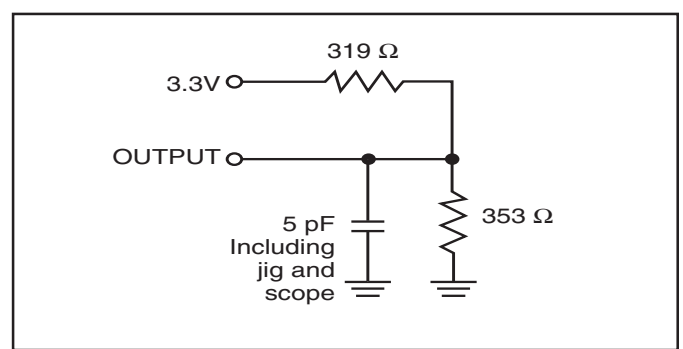


Figure 2.

**POWER SUPPLY CHARACTERISTICS<sup>(1)</sup>** (Over Operating Range)

Symbol	Parameter	Test Conditions		-25		-35		Unit
				Min.	Max.	Min.	Max.	
I <sub>CC</sub>	V <sub>DD</sub> Dynamic Operating Supply Current	V <sub>DD</sub> = Max.,	Com.	—	30	—	25	mA
		I <sub>OUT</sub> = 0 mA, f = f <sub>MAX</sub>	Ind.	—	35	—	30	
		V <sub>IN</sub> = 0.4V or V <sub>DD</sub> - 0.3V	Auto.	—	60	—	60	
				25				
I <sub>CC1</sub>	Operating Supply Current	V <sub>DD</sub> = Max.,	Com.	—	20	—	20	mA
		I <sub>OUT</sub> = 0 mA, f = 0	Ind.	—	30	—	30	
		V <sub>IN</sub> = 0.4V or V <sub>DD</sub> - 0.3V	Auto.	—	50	—	50	
I <sub>SB1</sub>	TTL Standby Current (TTL Inputs)	V <sub>DD</sub> = Max.,	Com.	—	15	—	15	mA
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	Ind.	—	20	—	20	
		$\overline{CS1} \geq V_{IH}$ , f = 0	Auto.	—	40	—	40	
I <sub>SB2</sub>	CMOS Standby Current (CMOS Inputs)	V <sub>DD</sub> = Max.,	Com.	—	0.8	—	0.8	mA
		$\overline{CS1} \geq V_{DD} - 0.2V$ ,	Ind.	—	1.2	—	1.2	
		V <sub>IN</sub> ≥ V <sub>DD</sub> - 0.2V, or V <sub>IN</sub> ≤ 0.2V, f = 0	Auto.	—	2	—	2	
				0.1				

**Note:**

1. At f = f<sub>MAX</sub>, address and data inputs are cycling at the maximum frequency, f = 0 means no input lines change.
2. Typical values are measured at V<sub>DD</sub> = 3.0V, T<sub>A</sub> = 25°C and not 100% tested.



### READ CYCLE SWITCHING CHARACTERISTICS<sup>(1)</sup> (Over Operating Range)

Symbol	Parameter	25 ns		35 ns		Unit
		Min.	Max.	Min.	Max.	
t <sub>RC</sub>	Read Cycle Time	25	—	35	—	ns
t <sub>AA</sub>	Address Access Time	—	25	—	35	ns
t <sub>OHA</sub>	Output Hold Time	3	—	3	—	ns
t <sub>ACS1</sub> /t <sub>ACS2</sub>	$\overline{CS1}/CS2$ Access Time	—	25	—	35	ns
t <sub>DOE</sub>	$\overline{OE}$ Access Time	—	12	—	15	ns
t <sub>HZOE</sub> <sup>(2)</sup>	$\overline{OE}$ to High-Z Output	—	8	—	10	ns
t <sub>LZOE</sub> <sup>(2)</sup>	$\overline{OE}$ to Low-Z Output	5	—	5	—	ns
t <sub>HZCS1</sub> /t <sub>HZCS2</sub> <sup>(2)</sup>	$\overline{CS1}/CS2$ to High-Z Output	0	8	0	10	ns
t <sub>LZCS1</sub> /t <sub>LZCS2</sub> <sup>(2)</sup>	$\overline{CS1}/CS2$ to Low-Z Output	10	—	10	—	ns
t <sub>BA</sub>	$\overline{LB}, \overline{UB}$ Access Time	—	25	—	35	ns
t <sub>HZB</sub>	$\overline{LB}, \overline{UB}$ to High-Z Output	0	8	0	10	ns
t <sub>LZB</sub>	$\overline{LB}, \overline{UB}$ to Low-Z Output	0	—	0	—	ns

**Notes:**

1. Test conditions assume signal transition times of 5 ns or less, timing reference levels of 0.9V/1.5V, input pulse levels of 0.4 to V<sub>DD</sub>-0.2V/0.4V to V<sub>DD</sub>-0.3V and output loading specified in Figure 1.
2. Tested with the load in Figure 2. Transition is measured ±500 mV from steady-state voltage. Not 100% tested.

### AC WAVEFORMS

#### READ CYCLE NO. 1<sup>(1,2)</sup> (Address Controlled) ( $\overline{CS1} = \overline{OE} = V_{IL}$ , $CS2 = \overline{WE} = V_{IH}$ , $\overline{UB}$ or $\overline{LB} = V_{IL}$ )



AC WAVEFORMS

READ CYCLE NO. 2<sup>(1,3)</sup> ( $\overline{CS1}$ ,  $\overline{CS2}$ ,  $\overline{OE}$ , AND  $\overline{UB}/\overline{LB}$  Controlled)



Notes:

1.  $\overline{WE}$  is HIGH for a Read Cycle.
2. The device is continuously selected.  $\overline{OE}$ ,  $\overline{CS1}$ ,  $\overline{UB}$ , or  $\overline{LB} = V_{IL}$ .  $CS2 = \overline{WE} = V_{IH}$ .
3. Address is valid prior to or coincident with  $\overline{CS1}$  LOW transition.

## WRITE CYCLE SWITCHING CHARACTERISTICS<sup>(1,2)</sup> (Over Operating Range)

Symbol	Parameter	25ns		35 ns		Unit
		Min.	Max.	Min.	Max.	
t <sub>WC</sub>	Write Cycle Time	25	—	35	—	ns
t <sub>SCS1</sub> /t <sub>SCS2</sub>	$\overline{CS1}$ /CS2 to Write End	18	—	25	—	ns
t <sub>AW</sub>	Address Setup Time to Write End	15	—	25	—	ns
t <sub>HA</sub>	Address Hold from Write End	0	—	0	—	ns
t <sub>SA</sub>	Address Setup Time	0	—	0	—	ns
t <sub>PWB</sub>	$\overline{LB}$ , $\overline{UB}$ Valid to End of Write	18	—	25	—	ns
t <sub>PWE</sub> <sup>(4)</sup>	$\overline{WE}$ Pulse Width	18	—	30	—	ns
t <sub>SD</sub>	Data Setup to Write End	12	—	15	—	ns
t <sub>HD</sub>	Data Hold from Write End	0	—	0	—	ns
t <sub>HZWE</sub> <sup>(3)</sup>	$\overline{WE}$ LOW to High-Z Output	—	12	—	20	ns
t <sub>LZWE</sub> <sup>(3)</sup>	$\overline{WE}$ HIGH to Low-Z Output	5	—	5	—	ns

### Notes:

1. Test conditions assume signal transition times of 5 ns or less, timing reference levels of 0.9V/1.5V, input pulse levels of 0.4 to V<sub>DD</sub>-0.2V/0.4V to V<sub>DD</sub>-0.3V and output loading specified in Figure 1.
2. The internal write time is defined by the overlap of  $\overline{CS1}$  LOW, CS2 HIGH 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.
3. Tested with the load in Figure 2. Transition is measured  $\pm 500$  mV from steady-state voltage. Not 100% tested.
4. t<sub>PWE</sub> > t<sub>HZWE</sub> + t<sub>SD</sub> when  $\overline{OE}$  is LOW.

## AC WAVEFORMS

### WRITE CYCLE NO. 1<sup>(1,2)</sup> ( $\overline{CS1}$ Controlled, $\overline{OE}$ = HIGH or LOW)



### Notes:

1. WRITE is an internally generated signal asserted during an overlap of the LOW states on the  $\overline{CS1}$ , CS2 and  $\overline{WE}$  inputs and at least one of the  $\overline{LB}$  and  $\overline{UB}$  inputs being in the LOW state.
2. WRITE = ( $\overline{CS1}$ ) [ ( $\overline{LB}$ ) = ( $\overline{UB}$ ) ] ( $\overline{WE}$ ).

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



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



WRITE CYCLE NO. 4 ( $\overline{UB}/\overline{LB}$  Controlled)



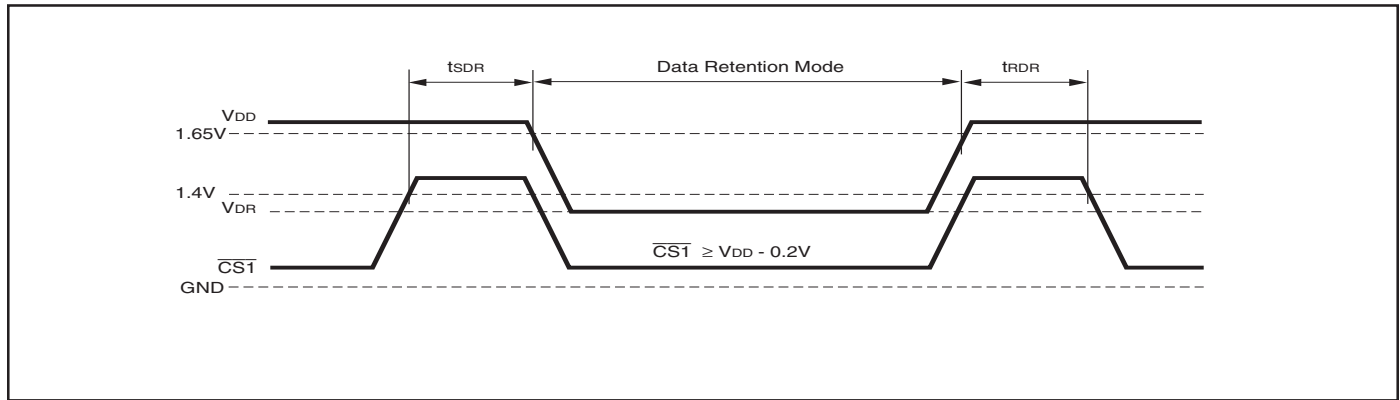
## DATA RETENTION SWITCHING CHARACTERISTICS

Symbol	Parameter	Test Condition	Min.	Typ. <sup>(1)</sup>	Max.	Unit
V <sub>DR</sub>	V <sub>DD</sub> for Data Retention	See Data Retention Waveform	1.2		3.6	V
I <sub>DR</sub>	Data Retention Current	V <sub>DD</sub> = 1.2V, $\overline{CS1} \geq V_{DD} - 0.2V$	—	0.1	0.8	mA
		Com.	—	0.1	1.2	
		Ind.	—	0.1	2	
t <sub>SDR</sub>	Data Retention Setup Time	See Data Retention Waveform	0		—	ns
t <sub>RDR</sub>	Recovery Time	See Data Retention Waveform	t <sub>RC</sub>		—	ns

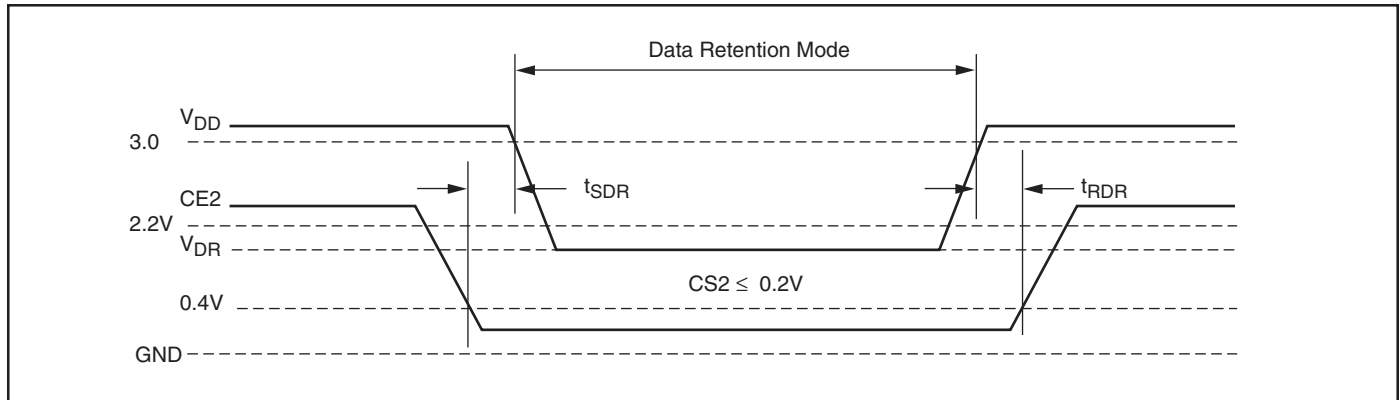
Note:

1. Typical values are measured at V<sub>DD</sub> = 3.0V, T<sub>A</sub> = 25°C and not 100% tested.

### DATA RETENTION WAVEFORM ( $\overline{CS1}$ Controlled)



### DATA RETENTION WAVEFORM (CS2 Controlled)



## ORDERING INFORMATION

**Industrial Range: -40°C to +85°C**

**Voltage Range: 2.4V to 3.6V**

Speed (ns)	Order Part No.	Package
25	IS62WV102416BLL-25MI	48 mini BGA (9mm x 11mm)
	IS62WV102416BLL-25MLI	48 mini BGA (9mm x 11mm), Lead-free
	IS62WV102416BLL-25TI	TSOP (Type I)
	IS62WV102416BLL-25TLI	TSOP (Type I), Lead-free

**Industrial Range: -40°C to +85°C**

**Voltage Range: 1.65V to 2.2V**

Speed (ns)	Order Part No.	Package
35	IS62WV102416ALL-35MI	48 mini BGA (9mm x 11mm)
	IS62WV102416ALL-35MLI	48 mini BGA (9mm x 11mm), Lead-free
	IS62WV102416ALL-35TI	TSOP (Type I)
	IS62WV102416ALL-35TLI	TSOP (Type I), Lead-free

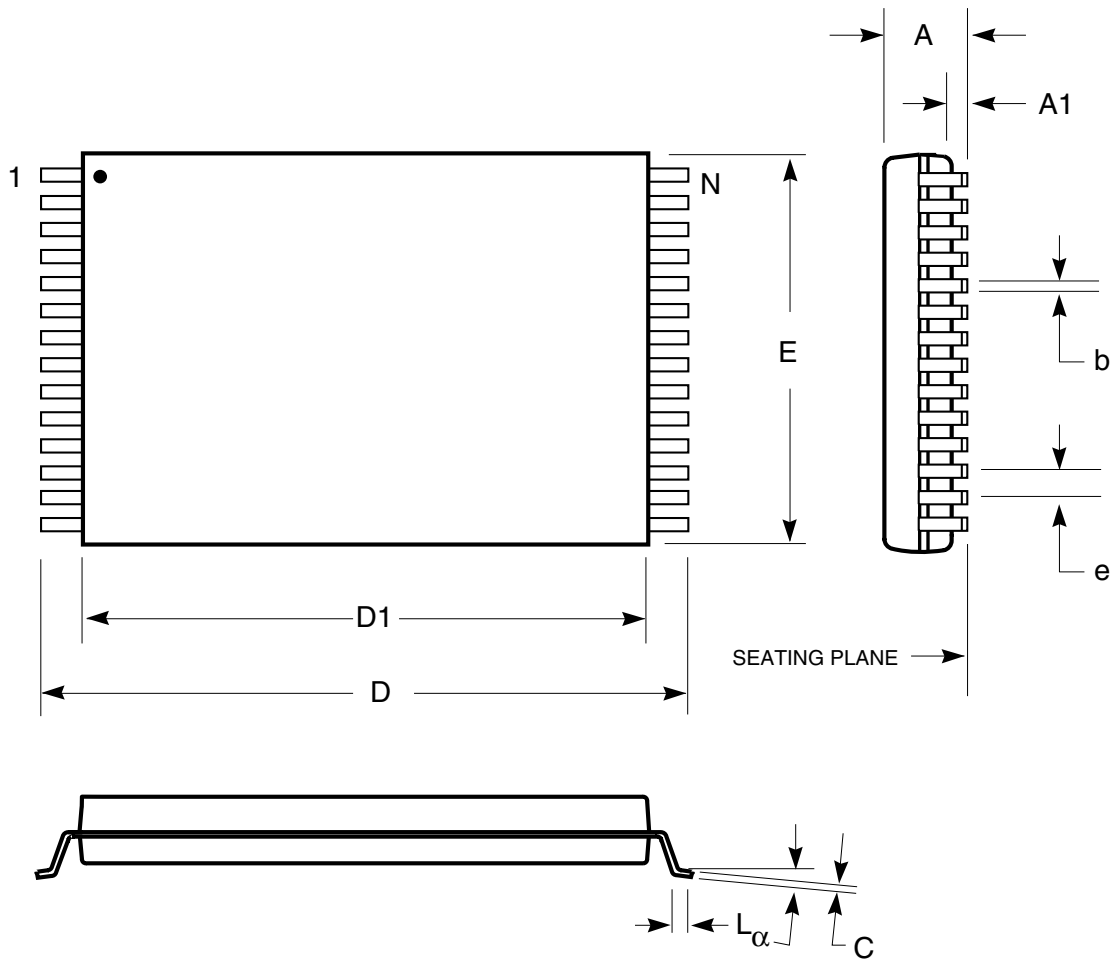
**Automotive Range: -40°C to +125°C**

**Voltage Range: 2.4V to 3.6V**

Speed (ns)	Order Part No.	Package
25	IS65WV102416BLL-25MA3	48 mini BGA (9mm x 11mm)
	IS65WV102416BLL-25TA3	TSOP (Type I)

# PACKAGING INFORMATION

Plastic TSOP - 48 pins  
 Package Code: T (Type I)

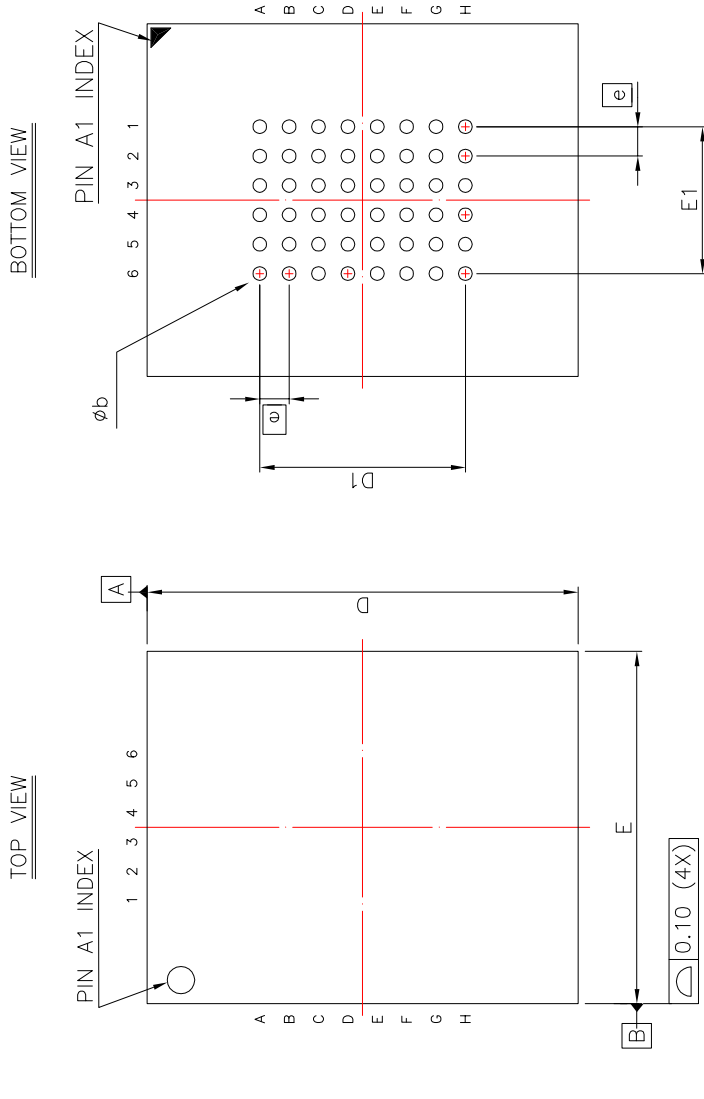


Plastic TSOP (T - Type I)				
	Millimeters		Inches	
Symbol	Min	Max	Min	Max
Ref. Std.				
N	48			
A	—	1.20	—	0.047
A1	0.05	0.15	0.002	0.006
b	0.17	0.27	0.007	0.011
C	0.10	0.21	0.004	0.008
D	19.8	20.2	0.780	0.795
D1	18.2	18.6	0.716	0.732
E	11.8	12.2	0.464	0.480
e	0.50 BSC		0.020 BSC	
L	0.50	0.70	0.020	0.028
alpha	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.





**NOTE :**

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

SYM.	DIMENSION (mm)			DIMENSION (INCH)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	—	—	1.20	—	—	0.047
A1	0.20	—	0.30	0.008	—	0.012
b	0.30	0.35	0.40	0.012	0.014	0.016
D	10.90	11.00	11.10	0.429	0.433	0.437
D1	5.25 BSC			0.207 BSC		
E	8.90	9.00	9.10	0.350	0.354	0.358
E1	3.75 BSC			0.148 BSC		
e	0.75 BSC			0.030 BSC		



TITLE

48L 9x11mm TF-BGA  
Package Outline

REV.

B

DATE

08/21/2008

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

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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