



**Preliminary**

# **16Mb Async. FAST SRAM B-die**

**Asynchronous FAST SRAM with ECC**

**1.65V ~ 3.6V**

- **S6R1616WEB**

**Datasheet**

## Features

- Fast Access Time : 8ns, 10ns, 12ns
- Embedded ECC
  - Single Bit Error Correction
- Wide range of Power Supply
  - 1.65V ~ 3.6V
- TTL Compatible Inputs and Outputs
- Three State Outputs
- Data Byte Control(x16 Mode)
  - $\overline{LB}$  : I/O7~ I/O0,  $\overline{UB}$  : I/O15~ I/O8
- Standard 48FBGA Package
- ROHS compliant
- Operating in Industrial Temperature range

## Performance

Operation	Symbol	Typical Value			Unit
		3.3V	2.5V	1.8V	
Read Cycle Time	$t_{RC}$	8/10(min.)	10(min.)	12(min.)	ns
Address Access Time	$t_{AA}$	8/10(min.)	10(min.)	12(min.)	ns
Write Cycle Time	$t_{WC}$	8/10(min.)	10(min.)	12(min.)	ns
Standby Current	$I_{SB1}$	TBD	TBD	TBD	mA
Operating Current	$I_{CC}$	TBD	TBD	TBD	mA

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## General Description

The S6R1616WEB is a 16,789,216-bit high-speed Static Random Access Memory organized as 1M words by 16 bits. The S6R1616WEB uses 16 common input and output lines and have an output enable pin which operates faster than address access time at read cycle.

And S6R1616WEB allows that lower and upper byte access by data byte control( $\overline{LB}$ ,  $\overline{UB}$ ). The device is fabricated using advanced CMOS process, 6-TR based cell technology and designed for high-speed circuit technology.

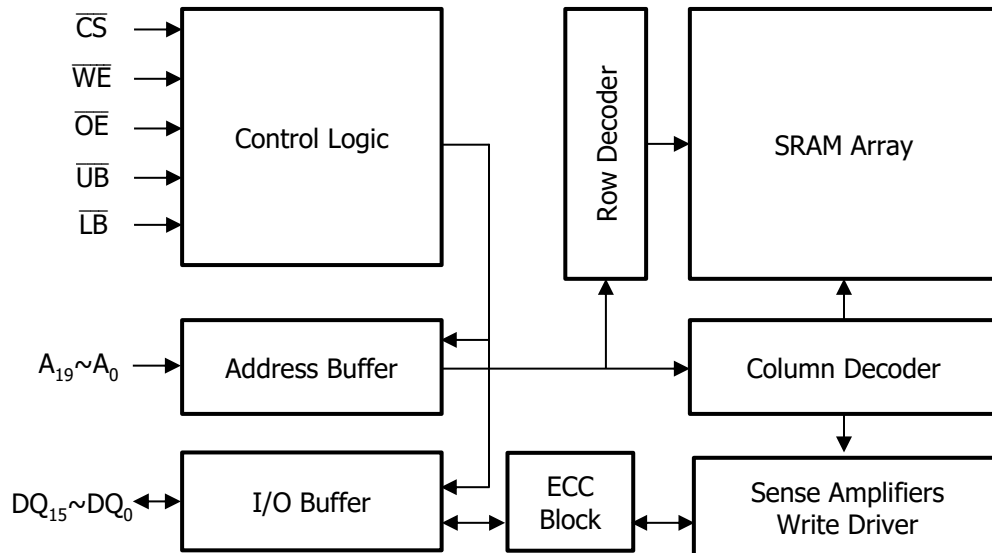
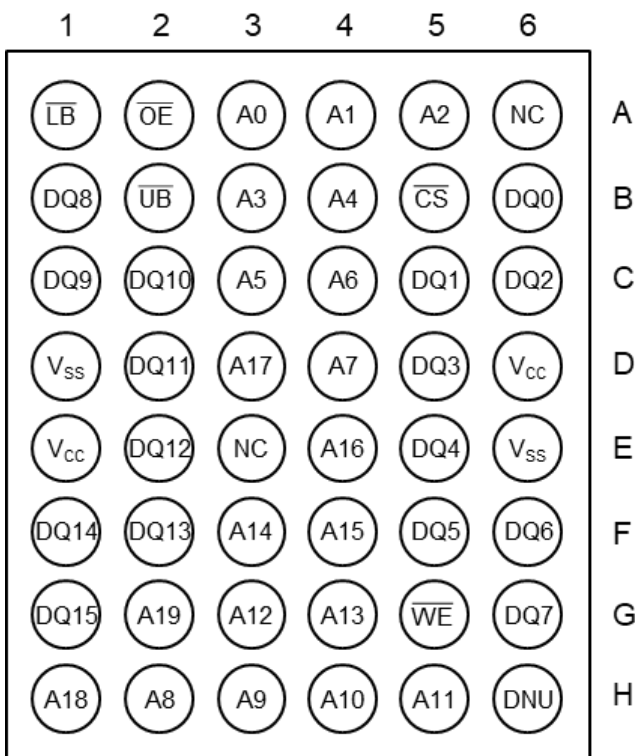
Single error correction logic is implemented for high reliability in devices. ECC logic can correct single bit error in read operation.

It is particularly well suited for use in high-reliable and high-speed system applications.

The S6R1616WEB is packaged in a 48 Ball FBGA.

## Asynchronous FAST SRAM Ordering Information

Density	Org.	Part Number	Vcc(V)	Speed (ns)		Package	Temperature
				tAA	tOE		
16Mb	1M x16	S6R1616WEB-XI08	3.3	8	4	48FBGA	Industrial Temperature
			2.5	10	5		
			1.8	12	6		
		S6R1616WEB-XI10	3.3	10	5	48FBGA	
			2.5	10	5		
			1.8	12	6		

**Logic Block Diagram – S6R1616WEB (1M x16)**

**48FBGA Package Pin Configuration (Top View) – S6R1616WEB (1M x16)**

**Pin Function**

Pin Name	Pin Function
A <sub>19</sub> ~A <sub>0</sub>	Address Inputs
$\overline{\text{WE}}$	Write Enable
$\overline{\text{CS}}$	Chip Select
$\overline{\text{OE}}$	Output Enable
$\overline{\text{LB}}$	Lower-byte Control( DQ <sub>7</sub> ~ DQ <sub>0</sub> )
$\overline{\text{UB}}$	Upper-byte Control( DQ <sub>15</sub> ~ DQ <sub>8</sub> )
DQ <sub>15</sub> ~DQ <sub>0</sub>	Data Inputs/Outputs
V <sub>CC</sub>	Power
V <sub>SS</sub>	Ground
NC	No Connection
DNU	Do Not Use : DNUs must be left unconnected.

## Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Voltage on Vcc Supply Relative to VSS	V <sub>in</sub> , V <sub>out</sub>	-0.5 to V <sub>cc</sub> +0.5V	V
Voltage on Any Pin Relative to VSS	V <sub>in</sub> , V <sub>out</sub>	-0.5 to 4.0	V
Power Dissipation	P <sub>D</sub>	1.0	W
Storage Temperature	P <sub>STG</sub>	-65 to 150	°C
Operating Ambient Temperature	T <sub>A</sub>	-40 to 85	°C

\* 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 at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Recommended DC Operating Conditions

Parameter	Operating Vcc(V)	Symbol	Min.	Typ.	Max.	Units
Vcc Supply Voltage	2.3 ~ 3.6	V <sub>cc</sub>	2.3	2.5/3.3	3.6	V
	1.65 ~ 2.2	V <sub>cc</sub>	1.65	1.8	2.2	V
Ground		V <sub>ss</sub>	0	0	0	V
Input High Voltage	2.3 ~ 3.6	V <sub>IH</sub>	2.0	-	V <sub>cc</sub> +0.3	V
	1.65 ~ 2.2	V <sub>IH</sub>	1.4	-	V <sub>cc</sub> +0.2	V
Input Low Voltage	2.3 ~ 3.6	V <sub>IL</sub>	-0.3	-	0.7	V
	1.65 ~ 2.2	V <sub>IL</sub>	-0.2	-	0.4	V

**DC and Operating Characteristics**

Parameters	Symbol	Test Conditions	Min	Typ	Max	Unit	
Input Leakage Current	$I_{LI}$	$V_{IN} = V_{SS} \text{ to } V_{CC}$	-2	-	+2	$\mu\text{A}$	
Output Leakage Current	$I_{LO}$	$\overline{CS}=V_{IH}$ or $\overline{OE}=V_{IH}$ or $\overline{WE}=V_{IL}$ $V_{OUT} = V_{SS} \text{ to } V_{CC}$	-2	-	+2	$\mu\text{A}$	
Operating Current	$I_{CC}$	$V_{CC} (\text{max}), f=f_{\text{max}}, I_{OUT}=0\text{mA}$ $V_{IN} \geq V_{CC}-0.2\text{V}$ or $V_{IN} \leq 0.2\text{V}$	8ns	-	TBD	TBD	mA
			10ns	-	TBD	TBD	
			12ns	-	TBD	TBD	
Standby Current	$I_{SB}$	$V_{CC} (\text{max}), f=f_{\text{max}}, \overline{CS} \geq V_{IH}$	-	TBD	TBD	mA	
	$I_{SB1}$	$V_{CC} (\text{max}), f=0, \overline{CS} \geq V_{CC}-0.2\text{V}$ $V_{IN} \geq V_{CC}-0.2\text{V}$ or $V_{IN} \leq 0.2\text{V}$	-	TBD	TBD		
Output Low Voltage	$V_{OL}$	$V_{CC}=3.0\text{V}, I_{OL}=8\text{mA}$	-	-	0.4	V	
		$V_{CC}=2.4\text{V}, I_{OL}=1\text{mA}$	-		0.4		
		$V_{CC}=1.65\text{V}, I_{OL}=0.1\text{mA}$	-		0.2		
Output High Voltage	$V_{OH}$	$V_{CC}=3.0\text{V}, I_{OH}=-4\text{mA}$	2.4	-	-	V	
		$V_{CC}=2.4\text{V}, I_{OH}=-1\text{mA}$	1.8		-		
		$V_{CC}=1.65\text{V}, I_{OH}=-0.1\text{mA}$	1.4		-		

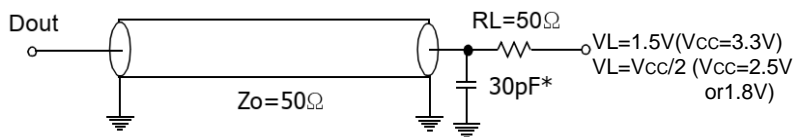
**Pin Capacitance**

Item	Symbol	Test Conditions	Typ	Max	Unit
Input/Output Capacitance	$C_{I/O}$	$V_{I/O}=0\text{V}$	-	16	pF
Input Capacitance	$C_{IN}$	$V_{IN}=0\text{V}$	-	14	pF

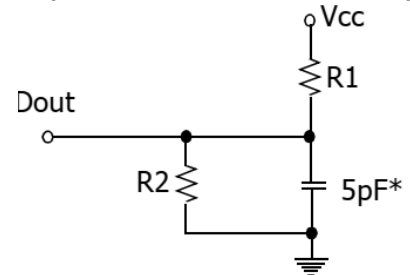
\*  $T_A=25^\circ\text{C}$ ,  $f=1.0\text{MHz}$ , Capacitance is sampled and not 100% tested.

**Test Conditions**

Parameter	Value
Input Pulse Level	0 to 3.0V (V <sub>CC</sub> =3.3V)
	0 to 2.5V (V <sub>CC</sub> =2.5V)
	0 to 1.8V (V <sub>CC</sub> =1.8V)
Input Rise and Fall Time	1V/1ns
Input and Output Timing Reference Levels	1.5V (V <sub>CC</sub> =3.3V)
	1/2V <sub>CC</sub> (V <sub>CC</sub> =2.5V or 1.8V)
Output Load	See Fig. 1

**Output Load (A)**

**Output Load(B)**

(for tHZ, tLZ, tWHZ, tOLZ &amp; tOHZ )



V <sub>CC</sub>	3.3V	2.5V	1.8V
<b>R1</b>	319Ω	1909Ω	13500Ω
<b>R2</b>	353Ω	1105Ω	10800Ω

\* Including Scope and Jig Capacitance



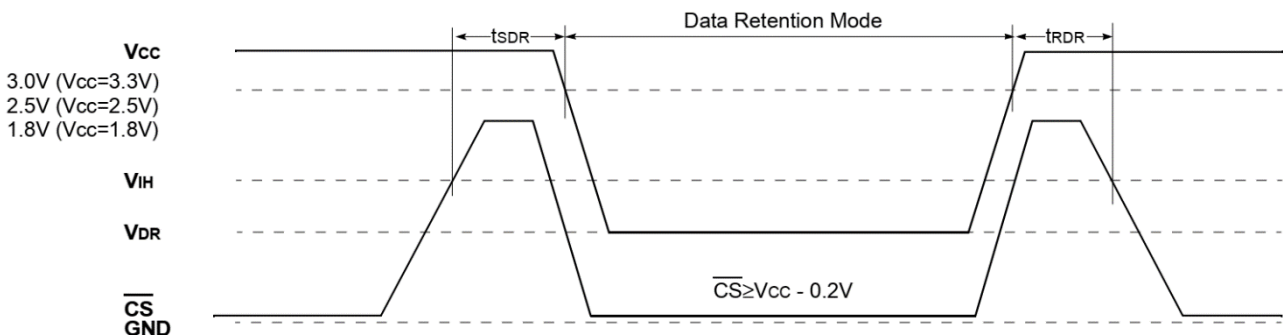
**Functional Description (x16 Mode)**

$\overline{\text{CS}}$	WE	OE	LB	UB	Modes	DQ Pins		Supply Current
						DQ <sub>7~DQ<sub>0</sub></sub>	DQ <sub>15~DQ<sub>8</sub></sub>	
H	X	X*	X	X	Not Selected	High-Z	High-Z	I <sub>SB</sub> , I <sub>SB1</sub>
L	H	H	X	X	Output Disable	High-Z	High-Z	I <sub>CC</sub>
L	X	X	H	H				
L	H	L	L	H	Read	Dout	High-Z	I <sub>CC</sub>
			H	L		High-Z	Dout	
			L	L		Dout	Dout	
L	L	X	L	H	Write	Din	High-Z	I <sub>CC</sub>
			H	L		High-Z	Din	
			L	L		Din	Din	

\* X means Don't Care.

**Data Retention Characteristics**

Parameter	Operating Vcc(V)	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Vcc for Data Retention	2.5/3.3	VDR	$\overline{\text{CS}} \geq V_{CC} - 0.2V$	2.0	-	-	V
	1.8			1.5	-	-	
Data Retention Current	2.5/3.3	IDR	Vcc=2.0V $\overline{\text{CS}} \geq V_{CC} - 0.2V$ $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$	-	TBD	TBD	mA
	1.8		Vcc=1.5V $\overline{\text{CS}} \geq V_{CC} - 0.2V$ $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$	-	TBD	TBD	
Data Retention Set-Up Time		tSDR	See Data Retention Wave form(below)	0	-	-	ns
Recovery Time		tRDR		1	-	-	ms

**Data Retention Wave Form ( $\overline{\text{CS}}$  Controlled)**


## AC Timing Parameters

### Read Cycle

Parameter	Symbol	8ns		10ns		12ns		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle Time	$t_{RC}$	8	-	10	-	12	-	ns
Address Access Time	$t_{AA}$	-	8	-	10	-	12	ns
Chip Enable to Output	$t_{CO}$	-	8	-	10	-	12	ns
Output Enable to Valid Output	$t_{OE}$	-	4	-	5	-	6	ns
$\overline{UB}$ , $\overline{LB}$ Access Time <sup>1)</sup>	$t_{BA}$	-	4	-	5	-	6	ns
Chip Enable to Low-Z Output	$t_{LZ}$	3	-	3	-	3	-	ns
Output Enable to Low-Z Output	$t_{OLZ}$	0	-	0	-	0	-	ns
$\overline{UB}$ , $\overline{LB}$ Enable to Low-Z Output <sup>1)</sup>	$t_{BLZ}$	0	-	0	-	0	-	ns
Chip Disable to High-Z Output	$t_{HZ}$	0	4	0	5	0	6	ns
Output Disable to High-Z Output	$t_{OHZ}$	0	4	0	5	0	6	ns
$\overline{UB}$ , $\overline{LB}$ Disable to High-Z Output <sup>1)</sup>	$t_{BHZ}$	0	4	0	5	0	6	ns
Output Hold from Address Change	$t_{OH}$	3	-	3	-	3	-	ns
Chip Selection to Power Up Time	$t_{PU}$	0	-	0	-	0	-	ns
Chip Selection to Power Down Time	$t_{PD}$	-	8	-	10	-	12	ns

**Notes:**

1. Those parameters are applied for x16 mode only.

### Write Cycle

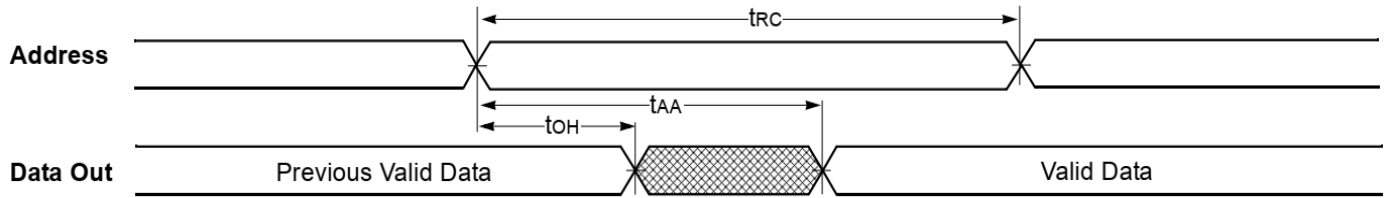
Parameter	Symbol	8ns		10ns		12ns		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
Write Cycle Time	$t_{WC}$	8	-	10	-	12	-	ns
Chip Enable to End of Write	$t_{CW}$	6	-	7	-	9	-	ns
Address Set-up Time	$t_{AS}$	0	-	0	-	0	-	ns
Address Valid to End of Write	$t_{AW}$	6	-	7	-	9	-	ns
Write Pulse Width ( $\overline{OE}$ High)	$t_{WP}$	6	-	7	-	9	-	ns
Write Pulse Width ( $\overline{OE}$ Low)	$t_{WP1}$	8	-	10	-	12	-	ns
$\overline{UB}$ , $\overline{LB}$ Valid to End of Write <sup>1)</sup>	$t_{BW}$	6	-	7	-	9	-	ns
Write Recovery Time	$t_{WR}$	0	-	0	-	0	-	ns
Write to Output High-Z	$t_{WHZ}$	0	4	0	5	0	6	ns
Data to Write Time Overlap	$t_{DW}$	4	-	5	-	7	-	ns
Data Hold from Write Time	$t_{DH}$	0	-	0	-	0	-	ns
End of Write to Output Low-Z	$t_{OW}$	3	-	3	-	3	-	ns

**Notes:**

1. Those parameters are applied for x16 mode only.

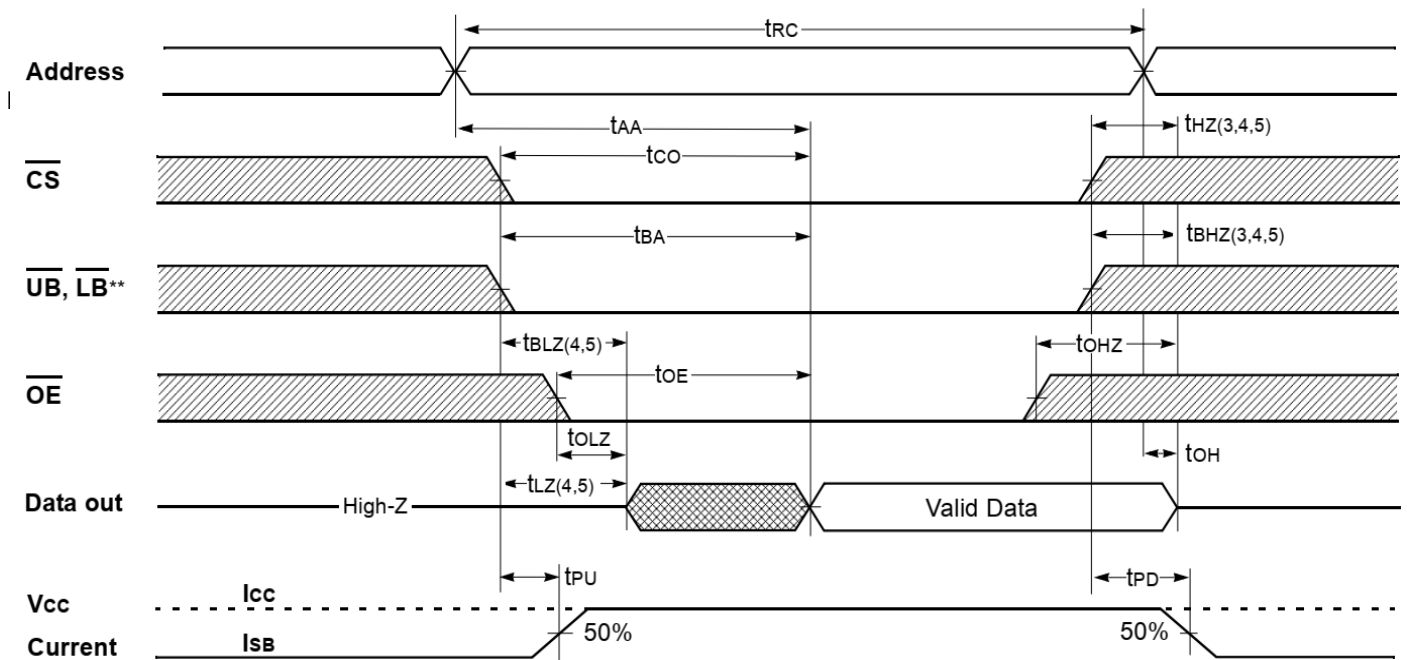
## Timing Diagrams

### Timing Waveform of Read Cycle(1) (Address Controlled, $\overline{CS} = \overline{OE} = V_{IL}$ , $\overline{WE} = V_{IH}$ , $\overline{UB}$ , $\overline{LB} = V_{IL}$ <sup>1)</sup>)


**Notes:**

1. Those parameters are applied for x16 mode only.

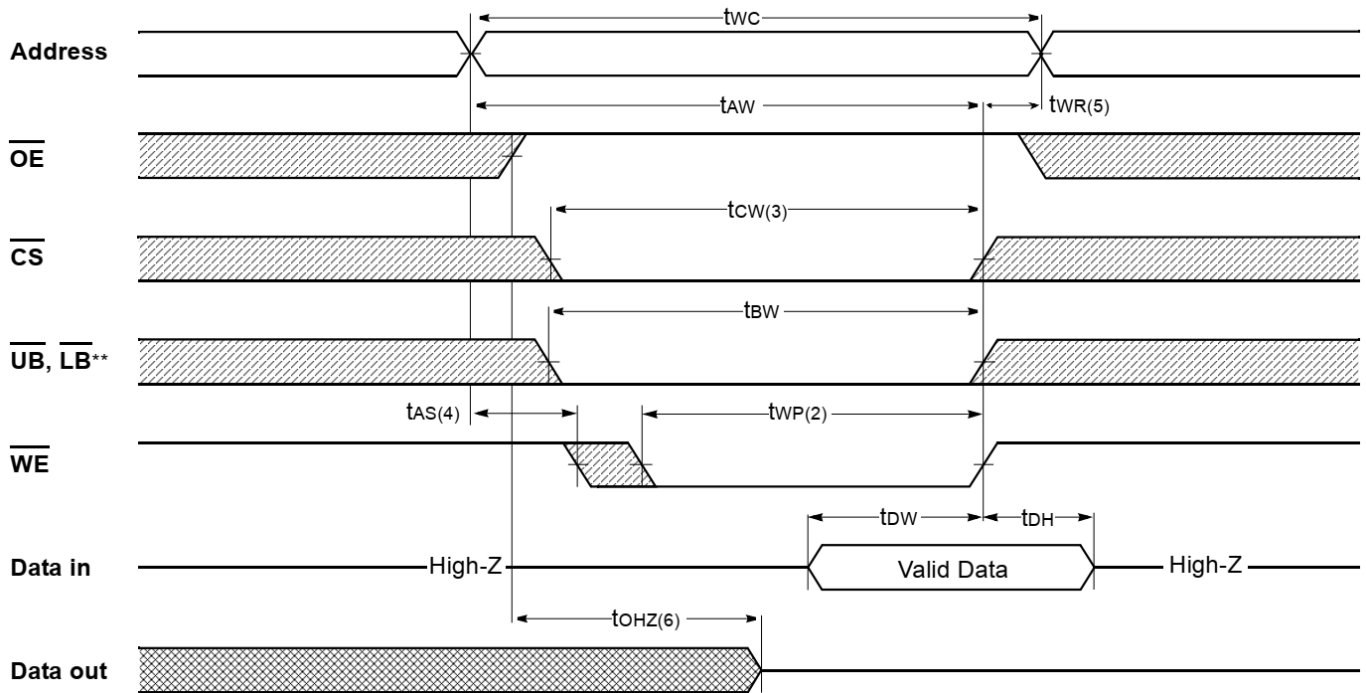
### Timing Waveform of Read Cycle(2) ( $\overline{WE} = V_{IH}$ )


**Notes (Read Cycle)**

1.  $\overline{WE}$  is high for read cycle.
2. All read cycle timing is referenced from the last valid address to the first transition address.
3.  $t_{HZ}$  and  $t_{OHZ}$  are defined as the time at which the outputs achieve the open circuit condition and are not referenced to  $V_{OH}$  or  $V_{OL}$  levels.
4. At any given temperature and voltage condition,  $t_{HZ}(\text{Max.})$  is less than  $t_{LZ}(\text{Min.})$  both for a given device and from device to device.
5. Transition is measured  $\pm 200\text{mV}$  from steady state voltage with Load(B). This parameter is sampled and not 100% tested.
6. Device is continuously selected with  $\overline{CS} = V_{IL}$ .
7. Address valid prior to coincident with  $\overline{CS}$  transition low.
8. For common DQ applications, minimization or elimination of bus contention conditions is necessary during read and write cycle.

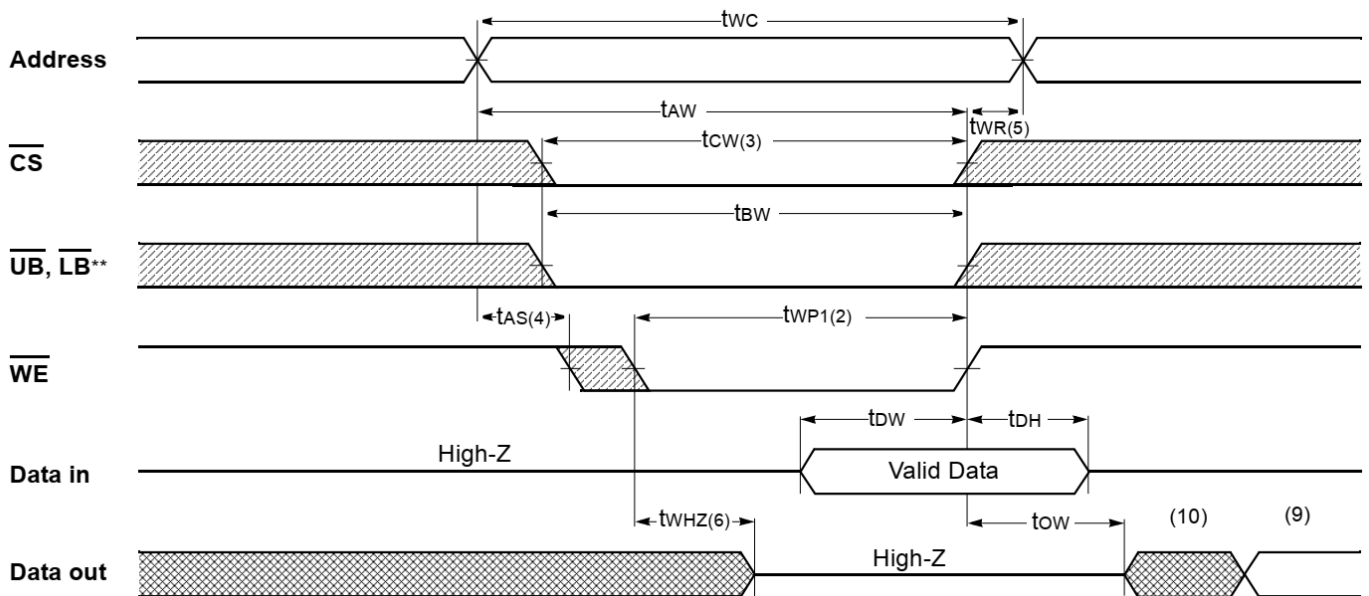
\*\* Those parameters are applied for x16 mode only.

**Timing Waveform of Write Cycle(1) (  $\overline{OE}$  Clock )**

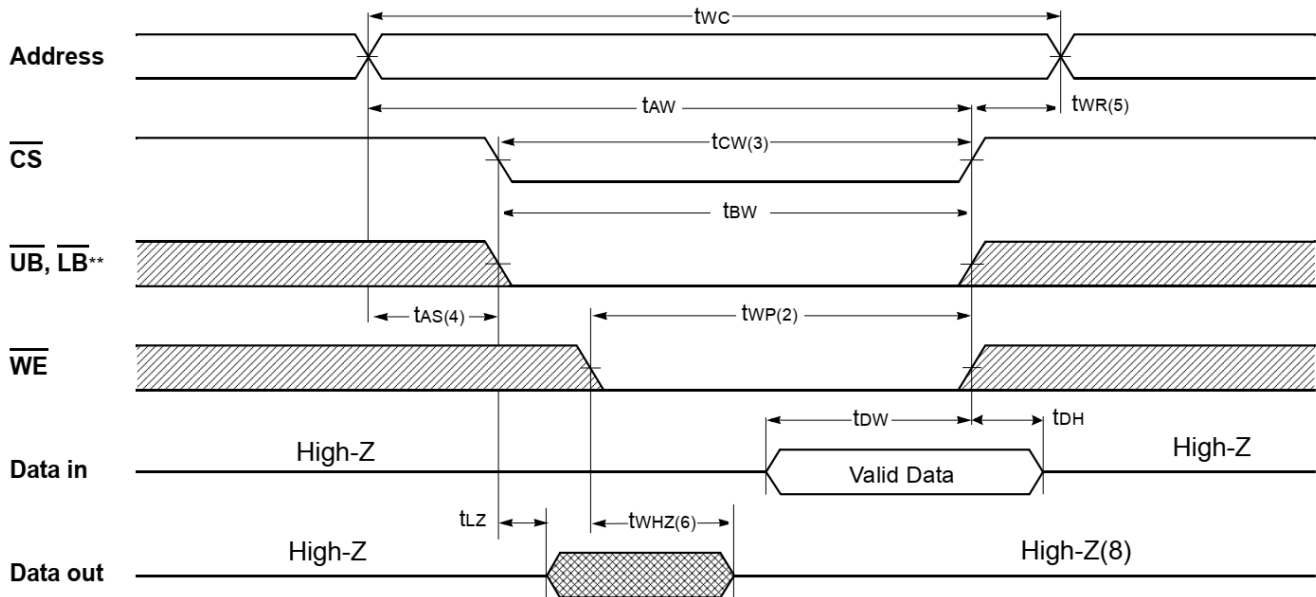


\*\* Those parameters are applied for x16 mode only.

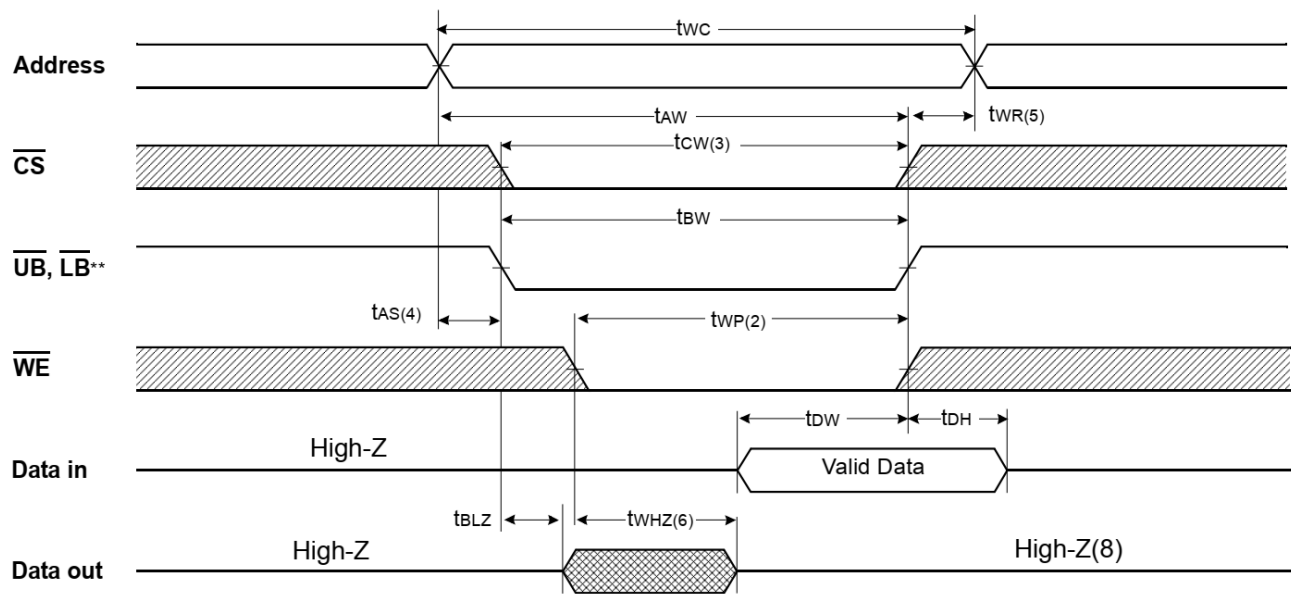
**Timing Waveform of Write Cycle(2) (  $\overline{OE}$  = Low Fix )**



\*\* Those parameters are applied for x16 mode only.

**Timing Waveform of Write Cycle(3) (  $\overline{CS}$  Controlled)**


\*\* Those parameters are applied for x16 mode only.

**Timing Waveform of Write Cycle(4) (  $\overline{UB}$ ,  $\overline{LB}$  Controlled)**

**Notes (Write Cycle)**

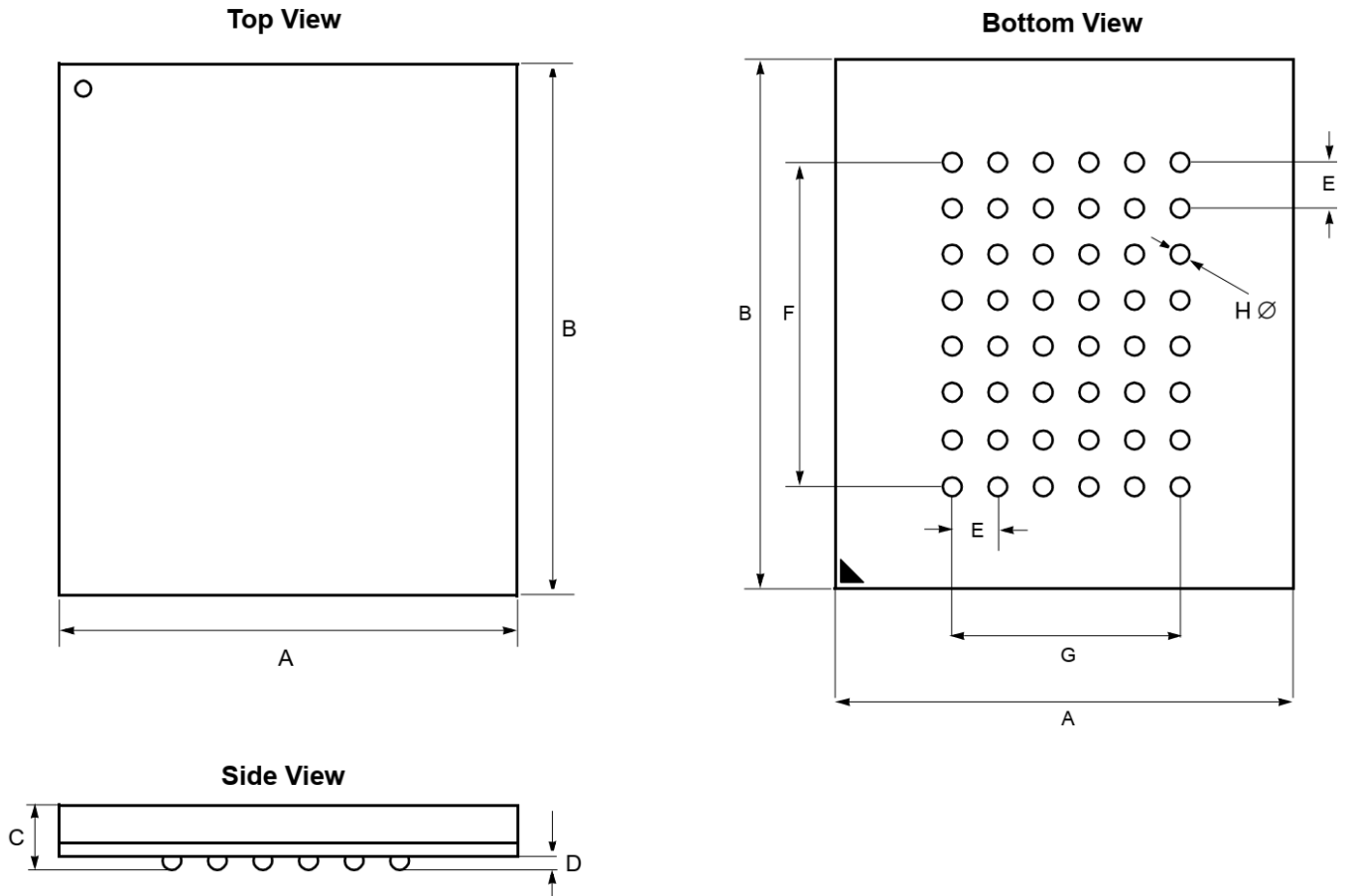
1. All write cycle timing is referenced from the last valid address to the first transition address.
2. A write occurs during the overlap of a low  $\overline{CS}$ ,  $\overline{WE}$ ,  $\overline{LB}$  and  $\overline{UB}$ . A write begins at the latest transition  $\overline{CS}$  going low and  $\overline{WE}$  going low ; A write ends at the earliest transition  $\overline{CS}$  going high or  $\overline{WE}$  going high.  $tWP$  is measured from the beginning of write to the end of write.
3.  $t_{cw}$  is measured from the later of  $\overline{CS}$  going low to end of write.
4.  $t_{as}$  is measured from the address valid to the beginning of write.
5.  $t_{wr}$  is measured from the end of write to the address change.  $t_{wr}$  applied in case a write ends as  $\overline{CS}$  or  $\overline{WE}$  going high.
6. If  $\overline{OE}$ ,  $\overline{CS}$  and  $\overline{WE}$  are in the Read Mode during this period, the I/O pins are in the output low-Z state. Inputs of opposite phase of the output must not be applied because bus contention can occur.
7. For common I/O applications, minimization or elimination of bus contention conditions is necessary during read and write cycle.
8. If  $\overline{CS}$  goes low simultaneously with  $\overline{WE}$  going or after  $\overline{WE}$  going low, the outputs remain high impedance state.
9.  $D_{out}$  is the read data of the new address.
10. When  $\overline{CS}$  is low : I/O pins are in the output state. The input signals in the opposite phase leading to the output should not be applied.

\*\* Those parameters are applied for x16 mode only.

## Package Dimensions

### 48FBGA

6mm x 8mm Body, 0.75mm Bump Pitch, 6 x 8 Ball Grid Array



Symbol	Value	Units	Note	Symbol	Value	Units	Note
<b>A</b>	6 ± 0.1	mm		<b>E</b>	0.75	mm	
<b>B</b>	8 ± 0.1	mm		<b>F</b>	5.25	mm	
<b>C</b>	1.1 ± 0.1	mm		<b>G</b>	3.75	mm	
<b>D</b>	0.25 ± 0.05	mm		<b>H</b>	0.35 ± 0.05	mm	

## Revision History

<b>Revision</b>	<b>Date</b>	<b>Description</b>
0.0	Aug. 2023	Initial Release, Preliminary

\* Products and specifications discussed herein are subject to change by Netsol without notice.