

## Revision History

### 1024K x 16 BIT SUPER LOW POWER CMOS SRAM

Revision	Details	Date
Rev 1.0	Initial Release	Nov 2020

## FEATURES

- Fast access time : 45/55ns
- Low power consumption:  
Operating current: 12/10mA (TYP.)  
Standby current: 5 $\mu$ A (TYP.)
- Single 2.7V ~ 3.6V power supply
- All inputs and outputs TTL compatible
- Fully static operation
- Tri-state output
- Data byte control :  
LB# (DQ0 ~ DQ7)  
UB# (DQ8 ~ DQ15)
- Data retention voltage: 1.5V (MIN.)
- Package: 48-pin 12mm x 20mm TSOP I  
48-ball 6mm x 8mm TFBGA

## GENERAL DESCRIPTION

The AS6C1616B is a 16,777,216-bit low power CMOS static random access memory organized as 1,048,576 words by 16 bits. It is fabricated using very high performance, high reliability CMOS technology. Its standby current is stable within the range of operating temperature.

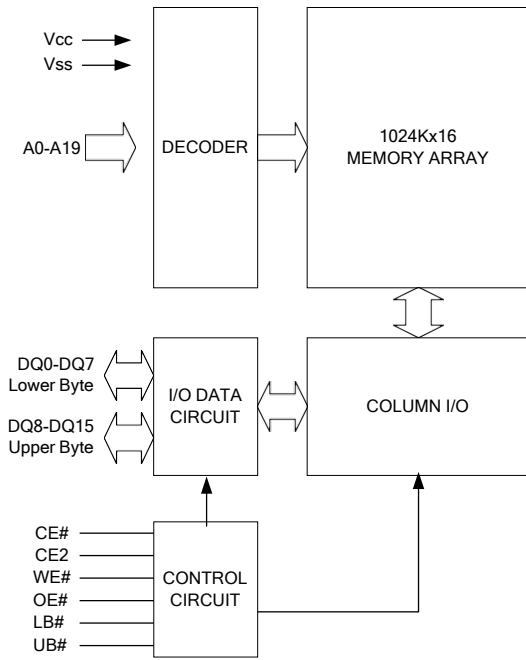
The AS6C1616B is well designed for low power application, and particularly well suited for battery back-up nonvolatile memory application.

The AS6C1616B operates from a single power supply of 2.7V ~ 3.6V and all inputs and outputs are fully TTL compatible

## PRODUCT FAMILY

Product Family	Operating Temperature	V <sub>CC</sub> Range	Speed	Power Dissipation	
				Standby(I <sub>SB1</sub> ,TYP.)	Operating(I <sub>CC</sub> ,TYP.)
AS6C1616B	-40 ~ 85°C	2.7 ~ 3.6V	45ns	5 $\mu$ A	12mA
AS6C1616B	-40 ~ 85°C	2.7 ~ 3.6V	55ns	5 $\mu$ A	10mA

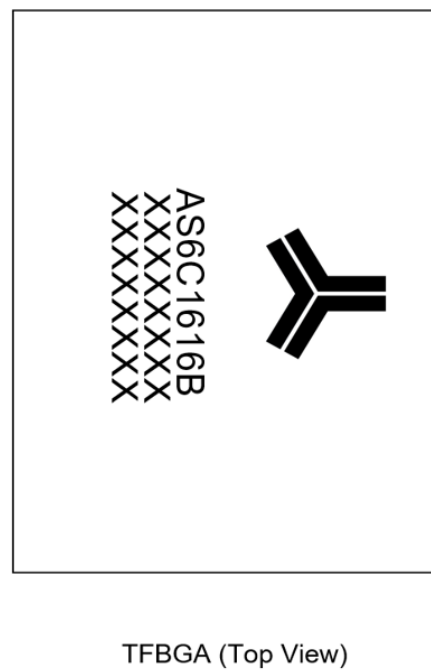
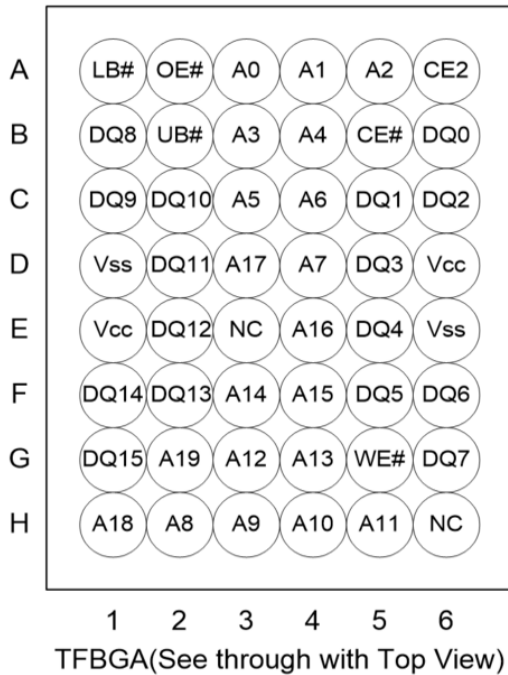
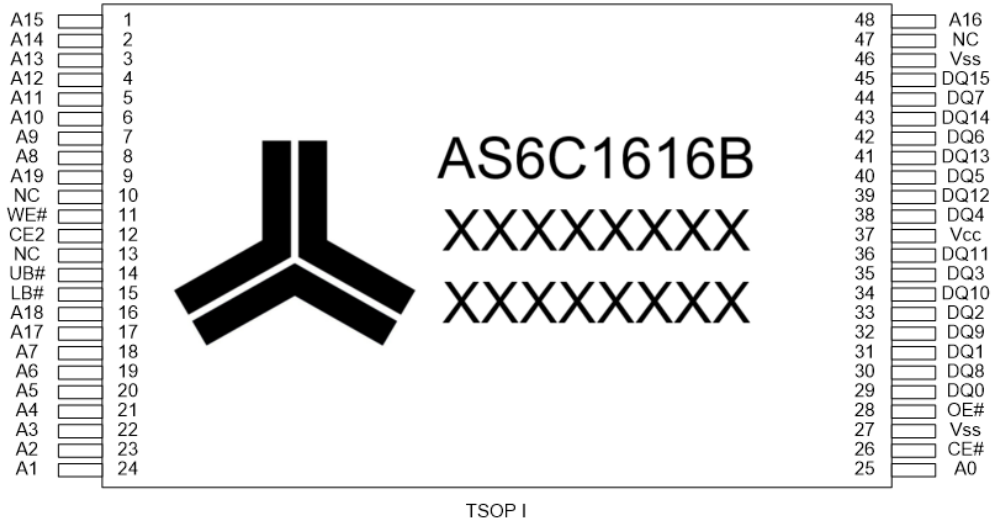
## FUNCTIONAL BLOCK DIAGRAM



## PIN DESCRIPTION

SYMBOL	DESCRIPTION
A0 - A19	Address Inputs
DQ0 – DQ15	Data Inputs/Outputs
CE#, CE2	Chip Enable Input
WE#	Write Enable Input
OE#	Output Enable Input
LB#	Lower Byte Control
UB#	Upper Byte Control
Vcc	Power Supply
Vss	Ground

## PIN CONFIGURATION



## ABSOLUTE MAXIMUM RATINGS\*

PARAMETER	SYMBOL	RATING	UNIT
Voltage on $V_{CC}$ relative to $V_{SS}$	$V_{T1}$	-0.5 to 4.6	V
Voltage on any other pin relative to $V_{SS}$	$V_{T2}$	-0.5 to $V_{CC}+0.5$	V
Operating Temperature (I grade)	$T_A$	-40 to 85	°C
Storage Temperature	$T_{STG}$	-65 to 150	°C
Power Dissipation	$P_D$	1	W
DC Output Current	$I_{OUT}$	50	mA

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

## TRUTH TABLE

MODE	CE#	CE2	OE#	WE#	LB#	UB#	I/O OPERATION		SUPPLY CURRENT
							DQ0-DQ7	DQ8-DQ15	
Standby	H	X	X	X	X	X	High – Z	High – Z	$I_{SB1}$
	X	L	X	X	X	X	High – Z	High – Z	
	X	X	X	X	H	H	High – Z	High – Z	
Output Disable	L	H	H	H	L	X	High – Z	High – Z	$I_{CC}, I_{CC1}$
	L	H	H	H	X	L	High – Z	High – Z	
Read	L	H	L	H	L	H	$D_{OUT}$	High – Z	$I_{CC}, I_{CC1}$
	L	H	L	H	H	L	High – Z	$D_{OUT}$	
	L	H	L	H	L	L	$D_{OUT}$	$D_{OUT}$	
Write	L	H	X	L	L	H	$D_{IN}$	High – Z	$I_{CC}, I_{CC1}$
	L	H	X	L	H	L	High – Z	$D_{IN}$	
	L	H	X	L	L	L	$D_{IN}$	$D_{IN}$	

Note: H =  $V_{IH}$ , L =  $V_{IL}$ , X = Don't care.

## DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP. <sup>*4</sup>	MAX.	UNIT		
Supply Voltage	$V_{CC}$		2.7	3.0	3.6	V		
Input High Voltage	$V_{IH}^{*1}$		2.2	-	$V_{CC}+0.3$	V		
Input Low Voltage	$V_{IL}^{*2}$		- 0.2	-	0.6	V		
Input Leakage Current	$I_{LI}$	$V_{CC} \geq V_{IN} \geq V_{SS}$	- 1	-	1	$\mu A$		
Output Leakage Current	$I_{LO}$	$V_{CC} \geq V_{OUT} \geq V_{SS}$ , Output Disabled	- 1	-	1	$\mu A$		
Output High Voltage	$V_{OH}$	$I_{OH} = -1mA$	2.2	2.7	-	V		
Output Low Voltage	$V_{OL}$	$I_{OL} = 2mA$	-	-	0.4	V		
Average Operating Power supply Current	$I_{CC}$	Cycle time = Min. $CE\# \leq 0.2V$ and $CE2 \geq V_{CC}-0.2V$ $I_{I/O} = 0mA$ Others at 0.2V or $V_{CC}-0.2V$	-45	-	12	20	mA	
			-55	-	10	18	mA	
	$I_{CC1}$	Cycle time = 1 $\mu s$ $CE\# \leq 0.2V$ and $CE2 \geq V_{CC}-0.2V$ $I_{I/O} = 0mA$ Other pins at 0.2V or $V_{CC}-0.2V$	-	-	3	5	mA	
Standby Power Supply Current	$I_{SB1}$	$CE\# \geq V_{CC}-0.2V$ or $CE2 \leq 0.2V$ Other pins at 0.2V or $V_{CC}-0.2V$	<sup>*5</sup>	40°C	-	5	10	$\mu A$
					-	5	40	$\mu A$

Notes:

- $V_{IH}(\max) = V_{CC} + 3.0V$  for pulse width less than 6ns.
  - $V_{IL}(\min) = V_{SS} - 3.0V$  for pulse width less than 6ns.
  - Over/Undershoot specifications are characterized, not 100% tested.
  - Typical values are included for reference only and are not guaranteed or tested.
- Typical values are measured at  $V_{CC} = V_{CC}(\text{TYP.})$  and  $T_A = 25^\circ C$
- This parameter is measured at  $V_{CC} = 3.0V$

## CAPACITANCE ( $T_A = 25^\circ C, f = 1.0MHz$ )

PARAMETER	SYMBOL	MIN.	MAX	UNIT
Input Capacitance	$C_{IN}$	-	6	pF
Input/Output Capacitance	$C_{I/O}$	-	8	pF

Note : These parameters are guaranteed by device characterization, but not production tested.

## AC TEST CONDITIONS

Input Pulse Levels	0.2V to $V_{CC} - 0.2V$
Input Rise and Fall Times	3ns
Input and Output Timing Reference Levels	1.5V
Output Load	$C_L = 30pF + 1TTL, I_{OH}/I_{OL} = -1mA/2mA$

## AC ELECTRICAL CHARACTERISTICS

### (1) READ CYCLE

PARAMETER	SYM.	AS6C1616B-45		AS6C1616B-55		UNIT
		MIN.	MAX.	MIN.	MAX.	
Read Cycle Time	$t_{RC}$	45	-	55	-	ns
Address Access Time	$t_{AA}$	-	45	-	55	ns
Chip Enable Access Time	$t_{ACE}$	-	45	-	55	ns
Output Enable Access Time	$t_{OE}$	-	25	-	30	ns
Chip Enable to Output in Low-Z	$t_{CLZ}^*$	10	-	10	-	ns
Output Enable to Output in Low-Z	$t_{OLZ}^*$	5	-	5	-	ns
Chip Disable to Output in High-Z	$t_{CHZ}^*$	-	15	-	20	ns
Output Disable to Output in High-Z	$t_{OHZ}^*$	-	15	-	20	ns
Output Hold from Address Change	$t_{OH}$	10	-	10	-	ns
LB#, UB# Access Time	$t_{BA}$	-	45	-	55	ns
LB#, UB# to High-Z Output	$t_{BHZ}^*$	-	20	-	25	ns
LB#, UB# to Low-Z Output	$t_{BLZ}^*$	10	-	10	-	ns

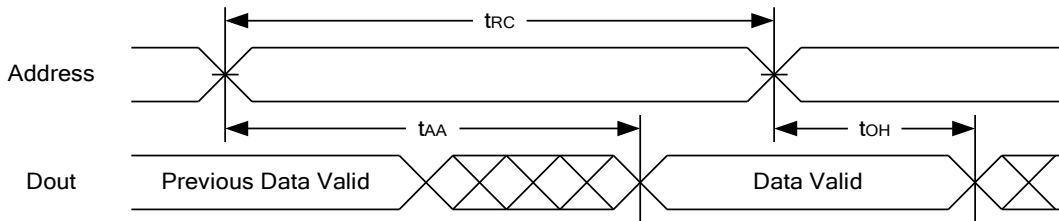
### (2) WRITE CYCLE

PARAMETER	SYM.	AS6C1616B-45		AS6C1616B-55		UNIT
		MIN.	MAX.	MIN.	MAX.	
Write Cycle Time	$t_{WC}$	45	-	55	-	ns
Address Valid to End of Write	$t_{AW}$	40	-	50	-	ns
Chip Enable to End of Write	$t_{CW}$	40	-	50	-	ns
Address Set-up Time	$t_{AS}$	0	-	0	-	ns
Write Pulse Width	$t_{WP}$	35	-	45	-	ns
Write Recovery Time	$t_{WR}$	0	-	0	-	ns
Data to Write Time Overlap	$t_{DW}$	20	-	25	-	ns
Data Hold from End of Write Time	$t_{DH}$	0	-	0	-	ns
Output Active from End of Write	$t_{OW}^*$	5	-	5	-	ns
Write to Output in High-Z	$t_{WHZ}^*$	-	15	-	20	ns
LB#, UB# Valid to End of Write	$t_{BW}$	35	-	45	-	ns

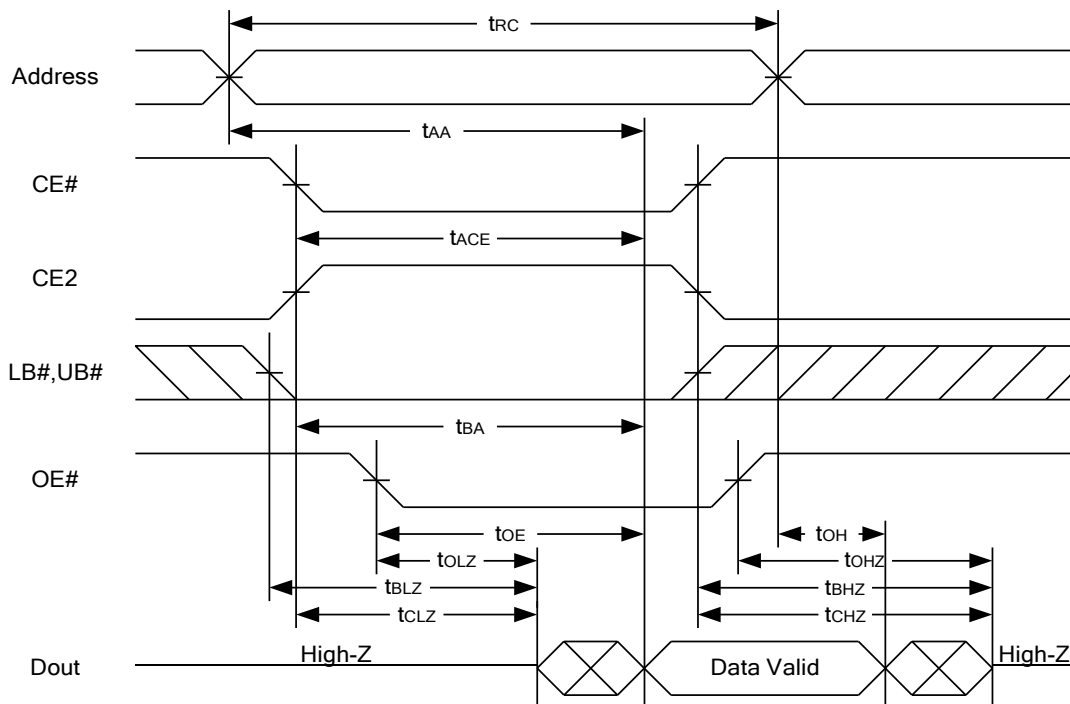
\*These parameters are guaranteed by device characterization, but not production tested.

## TIMING WAVEFORMS

### READ CYCLE 1 (Address Controlled) (1,2)



### READ CYCLE 2 (CE# and CE2 and OE# Controlled) (1,3,4,5)

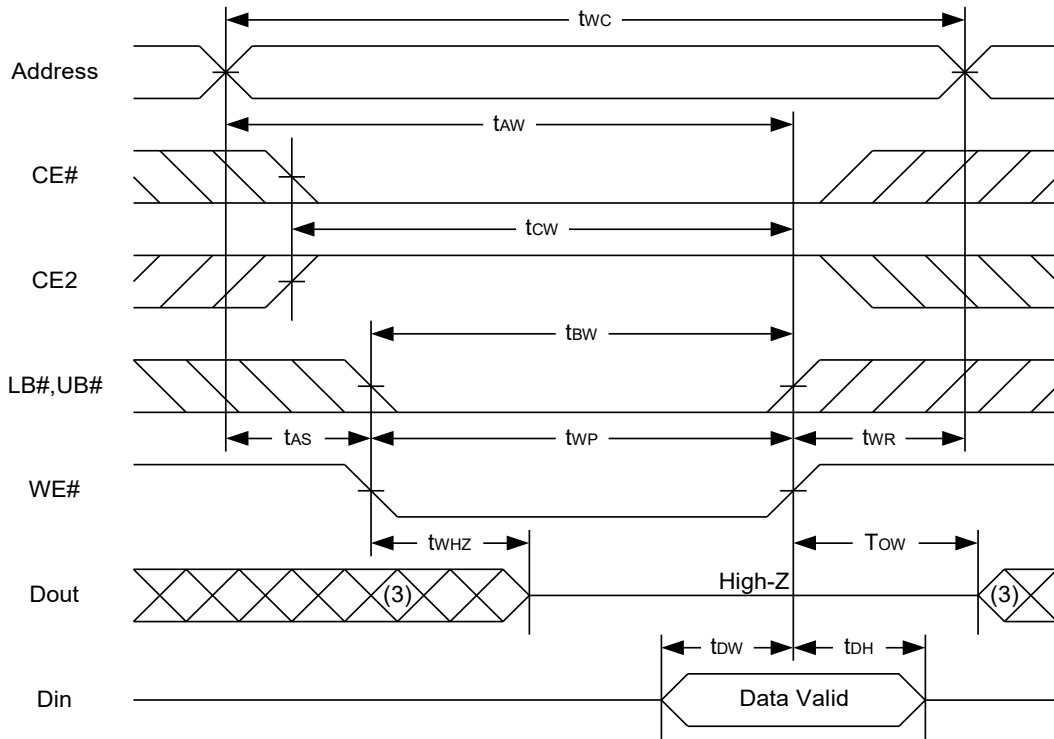


#### Notes :

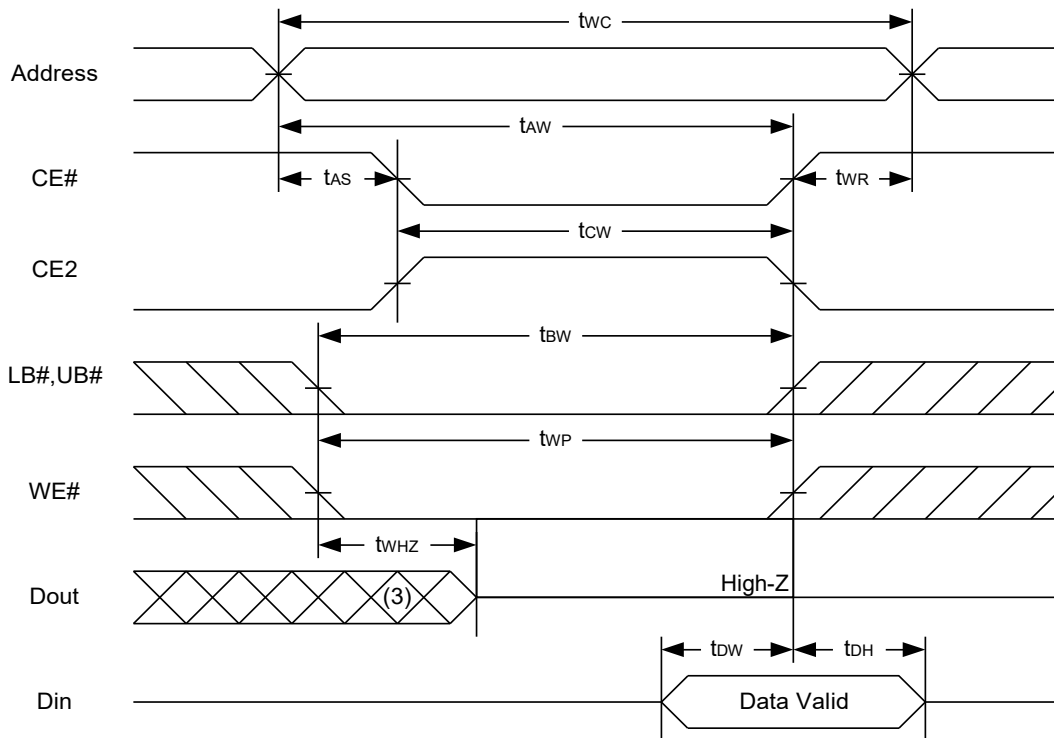
1. WE# is high for read cycle.
2. Device is continuously selected OE# = low, CE# = low, CE2 = high, LB# or UB# = low.
3. Address must be valid prior to or coincident with CE# = low, CE2 = high, LB# or UB# = low transition; otherwise t<sub>AA</sub> is the limiting parameter.
4. t<sub>CLZ</sub>, t<sub>BLZ</sub>, t<sub>OLZ</sub>, t<sub>CHZ</sub>, t<sub>BHZ</sub> and t<sub>OHZ</sub> are specified with C<sub>L</sub> = 5pF. Transition is measured ±500mV from steady state.
5. At any given temperature and voltage condition, t<sub>CHZ</sub> is less than t<sub>CLZ</sub>, t<sub>BHZ</sub> is less than t<sub>BLZ</sub>, t<sub>OHZ</sub> is less than t<sub>OLZ</sub>.



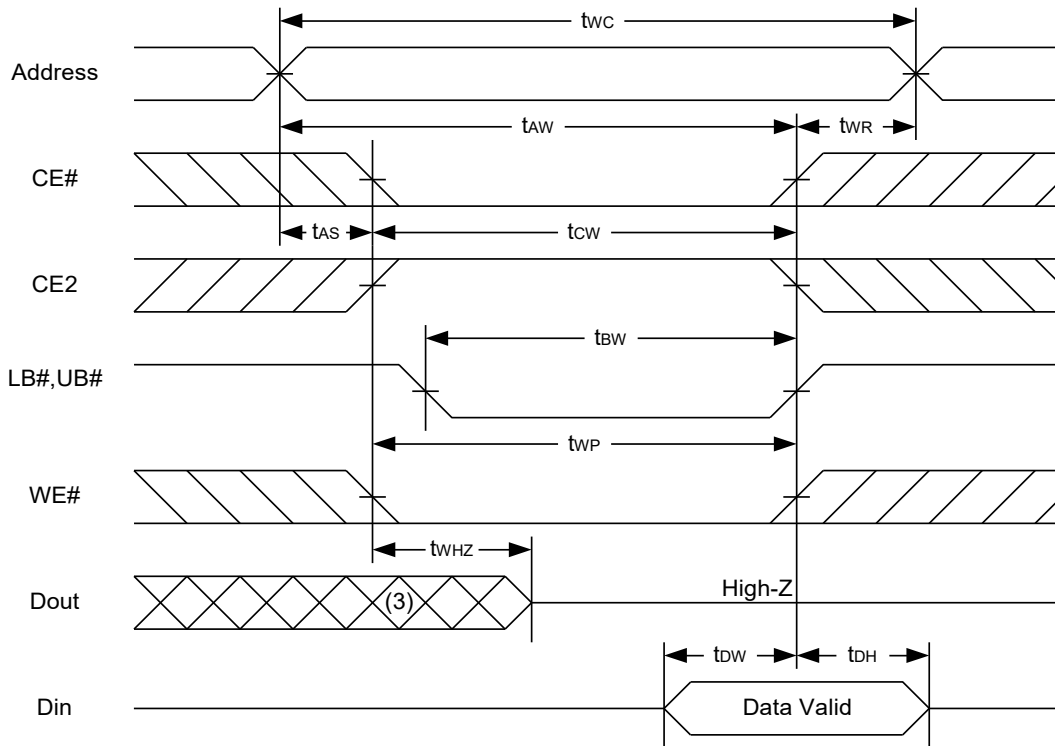
### WRITE CYCLE 1 (WE# Controlled) (1,2,4,5)



### WRITE CYCLE 2 (CE# and CE2 Controlled) (1,4,5)



### WRITE CYCLE 3 (LB#,UB# Controlled) (1,4,5)



**Notes :**

1. A write occurs during the overlap of a low CE#, high CE2, low WE#, LB# or UB# = low.
2. During a WE# controlled write cycle with OE# low,  $t_{WP}$  must be greater than  $t_{WHZ} + t_{DW}$  to allow the drivers to turn off and data to be placed on the bus.
3. During this period, I/O pins are in the output state, and input signals must not be applied.
4. If the CE#, LB#, UB# low transition and CE2 high transition occurs simultaneously with or after WE# low transition, the outputs remain in a high impedance state.
5.  $t_{OW}$  and  $t_{WHZ}$  are specified with  $C_L = 5pF$ . Transition is measured  $\pm 500mV$  from steady state.

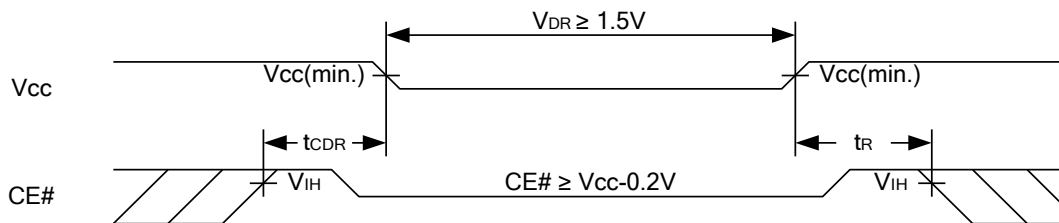
## DATA RETENTION CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
V <sub>CC</sub> for Data Retention	V <sub>DR</sub>	CE# ≥ V <sub>CC</sub> - 0.2V or CE2 ≤ 0.2V	1.5	-	3.6	V	
Data Retention Current	I <sub>DR</sub>	V <sub>CC</sub> = 1.5V CE# ≥ V <sub>CC</sub> -0.2V or CE2 ≤ 0.2V Other pins at 0.2V or V <sub>CC</sub> -0.2V	40°C	-	4	10	μA
				-	4	40	μA
Chip Disable to Data Retention Time	t <sub>CDR</sub>	See Data Retention Waveforms (below)	0	-	-	ns	
Recovery Time	t <sub>R</sub>		t <sub>RC</sub> *	-	-	ns	

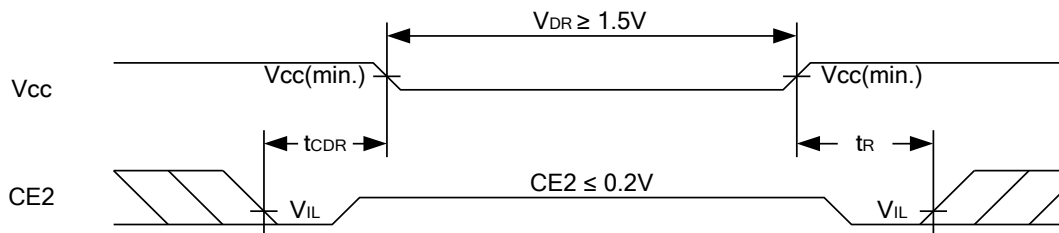
t<sub>RC</sub>\* = Read Cycle Time

## DATA RETENTION WAVEFORM

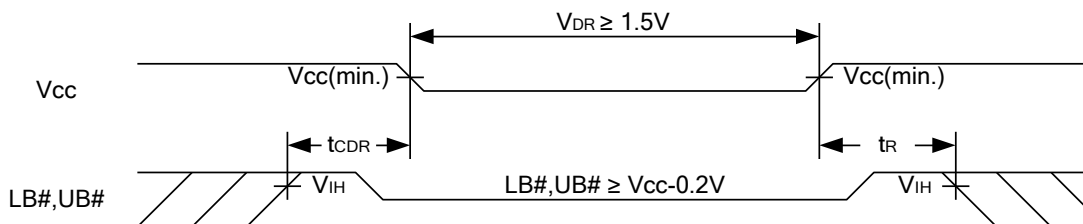
**Low V<sub>CC</sub> Data Retention Waveform (1)** (CE# controlled)



**Low V<sub>CC</sub> Data Retention Waveform (2)** (CE2 controlled)

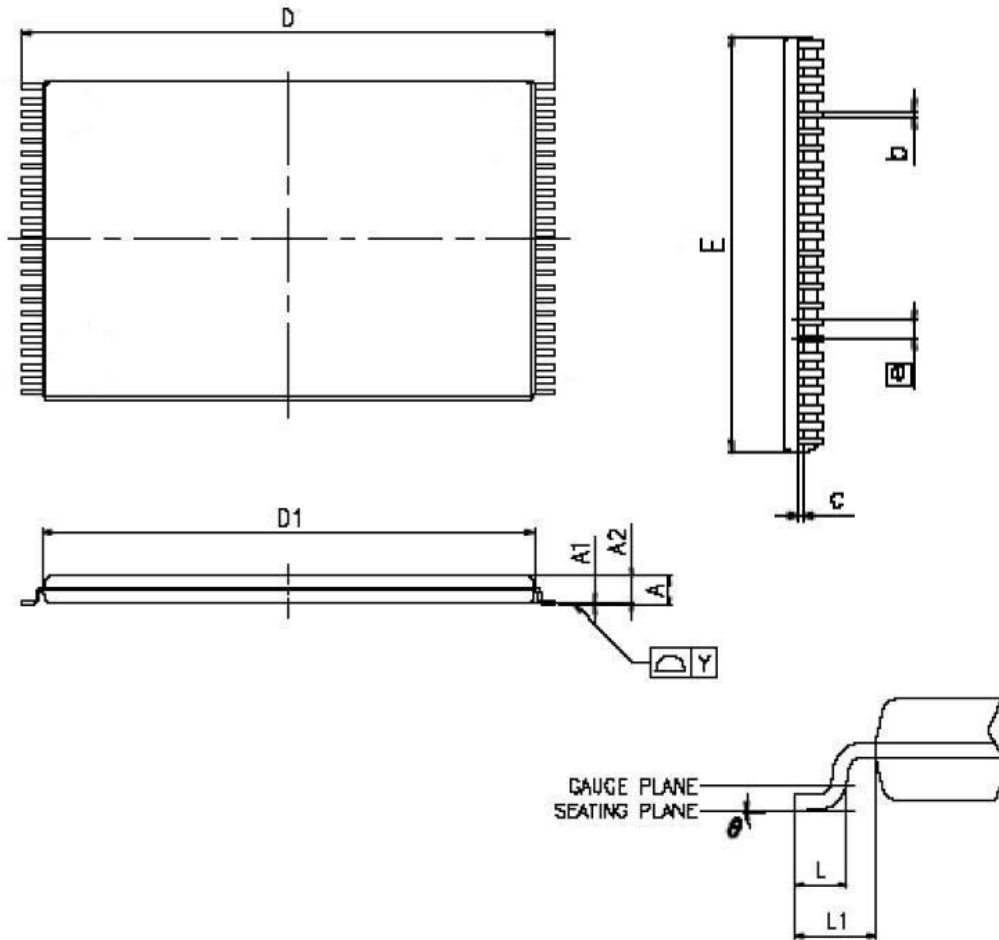


**Low V<sub>CC</sub> Data Retention Waveform (3)** (LB#, UB# controlled)



## PACKAGE OUTLINE DIMENSION

48-pin 12mm x 20mm TSOP I Package Outline Dimension



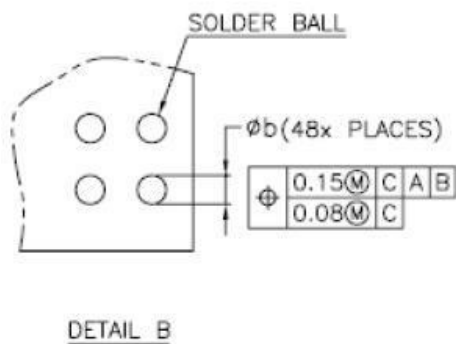
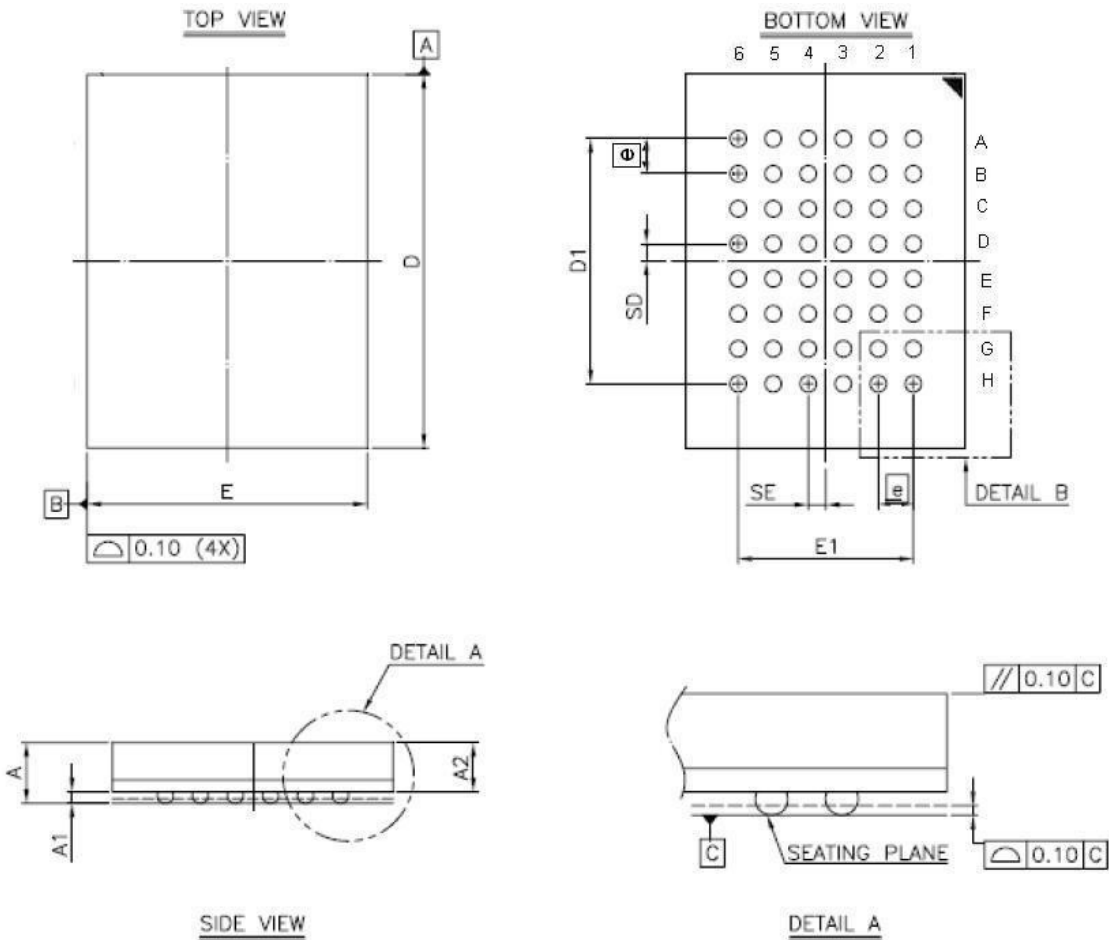
VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS	MIN.	NOM.	MAX
A	-	-	1.20
A1	0.05	-	0.15
A2	0.95	1.00	1.05
b	0.17	0.22	0.27
c	0.10	-	0.21
D	19.80	20.00	20.20
D1	18.30	18.40	18.50
E	11.90	12.00	12.10
Ⓜ	0.50 BASIC		
L	0.50	0.60	0.70
L1	-	0.80	-
Y	-	-	0.10
⊖	⊖	-	5°

NOTES:

- 1 JEDEC OUTLINE : MO-142 DD
2. PROFILE TOLERANCE ZONES FOR D1 AND E DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION ON E IS 0.15mm PER SIDE AND ON D1 IS 0.25mm PER SIDE.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08mm TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT.

## 48-ball 6mm × 8mm TFBGA Package Outline Dimension



A	—	—	1.40	—	—	0.055
A1	0.20	0.25	0.30	0.008	0.010	0.012
A2	—	—	1.05	—	—	0.041
b	0.30	0.35	0.40	0.012	0.014	0.016
D	7.95	8.00	8.05	0.313	0.315	0.317
D1	5.25 BSC			0.207 BSC		
E	5.95	6.00	6.05	0.234	0.236	0.238
E1	3.75 BSC			0.148 BSC		
SE	0.375 TYP			0.015 TYP		
SD	0.375 TYP			0.015 TYP		
Ⓢ	0.75 BSC			0.030 BSC		

**NOTE:**

1. CONTROLLING DIMENSION : MILLIMETER.
2. REFERENCE DOCUMENT : JEDEC MO-207.

## ORDERING INFORMATION

Alliance Part Number	Organization	VCC Range	Package	Operating Temp	Speed ns
AS6C1616B-45BIN	1024K x 16	2.7 ~ 3.6V	48ball 6mmx8mm FBGA	Industrial -40°C ~ 85°C	45
AS6C1616B-55BIN	1024K x 16	2.7 ~ 3.6V	48ball 6mmx8mm FBGA	Industrial -40°C ~ 85°C	55
AS6C1616B-45TIN	1024K x 16	2.7 ~ 3.6V	48pin 12mm x 20mm TSOP I	Industrial -40°C ~ 85°C	45
AS6C1616B-55TIN	1024K x 16	2.7 ~ 3.6V	48pin 12mm x 20mm TSOP I	Industrial -40°C ~ 85°C	55

## PART NUMBERING SYSTEM

AS6C	1616B	-45/55	B/T	I	N	XX
<b>AS6C</b> = Low Power SRAM	Device Number <b>16</b> = 16Meg <b>16</b> = x16 bit <b>B</b> = B die version	Access Time <b>45</b> = 45ns <b>55</b> = 55ns	<b>B</b> =FBGA <b>T</b> =TSOPI	<b>I</b> = Industrial Temp -40°C~ 85°C	Indicates Pb and Halogen Free	Packing Type <b>None</b> : Tray <b>TR</b> : Reel