

Revision History

16Mb (1M x16 / 2M x8) SUPER LOW POWER CMOS SRAM

Revision	Details	Date
Rev 1.0	Initial Release	May 2023

FEATURES

- Fast access time : 45ns
- Low power consumption:
 Operating current : 12mA (TYP.)
 Standby current : 5 μ A (TYP.)
- Single 2.7V ~ 3.6V power supply
- All inputs and outputs TTL compatible
- Fully static operation
- Tri-state output
- Data byte control :
 - (i) BYTE# fixed to V_{CC} configurable
 as 1M \times 16.
 LB# controlled DQ0 ~ DQ7
 UB# controlled DQ8 ~ DQ15
 - (ii) BYTE# fixed to V_{SS} configurable
 as 2M \times 8
 DQ15 used as address pin A-1,
 while DQ8~DQ14 pins not used
- Data retention voltage : 1.5V (MIN.)
- Package : 48-pin 12mm x 20mm TSOP I

GENERAL DESCRIPTION

The AS6C1616C is a 16,777,216-bit low power CMOS static random access memory organized as 1,048,576 words by 16 bits or 2,097,152 words by 8 bits. It is fabricated using very high performance, high reliability CMOS technology. Its standby current is stable within the range of operating temperature.

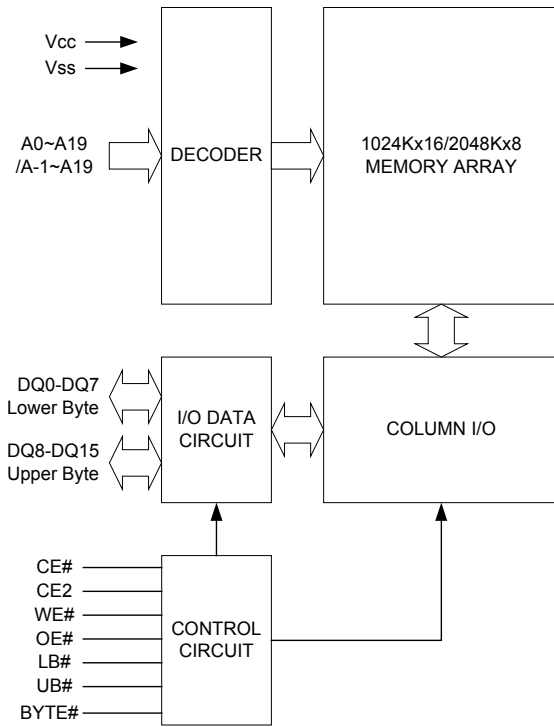
The AS6C1616C is well designed for low power application, and particularly well suited for battery back-up nonvolatile memory application.

The AS6C1616C 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 _{CC} Range	Speed	Power Dissipation	
				Standby(I _{SB1} ,TYP.)	Operating(I _{CC} ,TYP.)
AS6C1616C	-40 ~ 85°C	2.7 ~ 3.6V	45ns	5 μ A	12mA

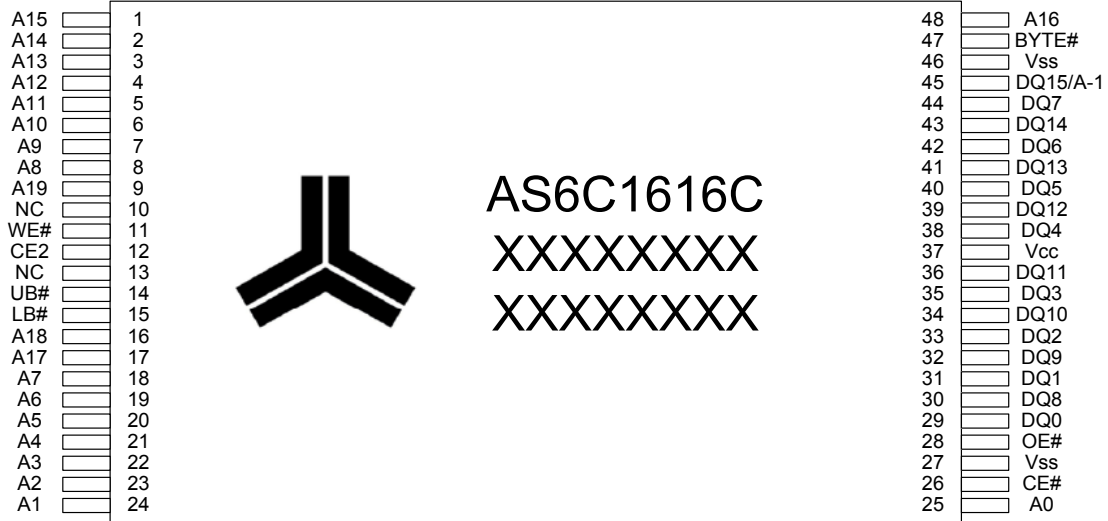
FUNCTIONAL BLOCK DIAGRAM



PIN DESCRIPTION

SYMBOL	DESCRIPTION
$A_0 \sim A_{19}$	Address Inputs(word mode)
$A_1 \sim A_{19}$	Address Inputs(byte mode)
$DQ_0 \sim DQ_{15}$	Data Inputs/Outputs
$CE\#, CE2$	Chip Enable Input
$WE\#$	Write Enable Input
$OE\#$	Output Enable Input
$LB\#$	Lower Byte Control
$UB\#$	Upper Byte Control
$BYTE\#$	Byte Enable
V_{CC}	Power Supply
V_{SS}	Ground
NC	No Connection

PIN CONFIGURATION



TSOP I

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	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	BYTE#	OE#	WE#	LB#	UB#	I/O OPERATION			SUPPLY CURRENT
								DQ0-DQ7	DQ8-DQ14	DQ15	
Standby	H	X	X	X	X	X	X	High-Z	High-Z	High-Z	I_{SB}, I_{SB1}
	X	L	X	X	X	X	X	High-Z	High-Z	High-Z	
	X	X	H	X	X	H	H	High-Z	High-Z	High-Z	
Output Disable	L	H	H	H	H	L	X	High-Z	High-Z	High-Z	I_{CC}, I_{CC1}
	L	H	H	H	H	X	L	High-Z	High-Z	High-Z	
	L	H	L	H	H	L	L	High-Z	High-Z	A-1	
Read	L	H	H	L	H	L	H	D _{OUT}	High-Z	High-Z	I_{CC}, I_{CC1}
	L	H	H	L	H	H	L	High-Z	D _{OUT}	D _{OUT}	
	L	H	H	L	H	L	L	D _{OUT}	D _{OUT}	D _{OUT}	
Write	L	H	H	X	L	L	H	D _{IN}	High-Z	High-Z	I_{CC}, I_{CC1}
	L	H	H	X	L	H	L	High-Z	D _{IN}	D _{IN}	
	L	H	H	X	L	L	L	D _{IN}	D _{IN}	D _{IN}	
Byte# Read	L	H	L	L	H	L	L	D _{OUT}	High-Z	A-1	I_{CC}, I_{CC1}
Byte # Write	L	H	L	X	L	L	L	D _{IN}	High-Z	A-1	I_{CC}, I_{CC1}

Notes:

1. H = V_{IH} , L = V_{IL} , X = Don't care.

2. The BYTE# pin has to be tied to V_{CC} to use the device as a 1M x 16 SRAM, and to be tied to V_{SS} as a 2M x 8 SRAM.

In the 2M x 8 configuration, Pin 45 is A-1, and both UB# and LB# are tied to V_{SS} , while DQ8 to DQ14 pins are not used.

DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP. *4	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	μA		
Output Leakage Current	I_{LO}	$V_{CC} \geq V_{OUT} \geq V_{SS}$, Output Disabled	- 1	-	1	μA		
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 $V_{CC}-0.2V$	-	12	20	mA		
	I_{CC1}	Cycle time = 1 μs $CE\# \leq 0.2V$ 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 $V_{CC}-0.2V$	*5	40°C	-	5	10	μA
					-	5	40	μA

Notes:

- $V_{IH}(\max) = V_{CC} + 2.0V$ for pulse width less than 6ns.
 - $V_{IL}(\min) = V_{SS} - 2.0V$ 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 $V_{CC} = V_{CC}(TYP.)$ 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.	AS6C1616C-45		UNIT
		MIN.	MAX.	
Read Cycle Time	t _{RC}	45	-	ns
Address Access Time	t _{AA}	-	45	ns
Chip Enable Access Time	t _{ACE}	-	45	ns
Output Enable Access Time	t _{OE}	-	25	ns
Chip Enable to Output in Low-Z	t _{CLZ} *	10	-	ns
Output Enable to Output in Low-Z	t _{OLZ} *	5	-	ns
Chip Disable to Output in High-Z	t _{CHZ} *	-	15	ns
Output Disable to Output in High-Z	t _{OHZ} *	-	15	ns
Output Hold from Address Change	t _{OH}	10	-	ns
LB#, UB# Access Time	t _{BA}	-	45	ns
LB#, UB# to High-Z Output	t _{BHZ} *	-	20	ns
LB#, UB# to Low-Z Output	t _{BLZ} *	10	-	ns

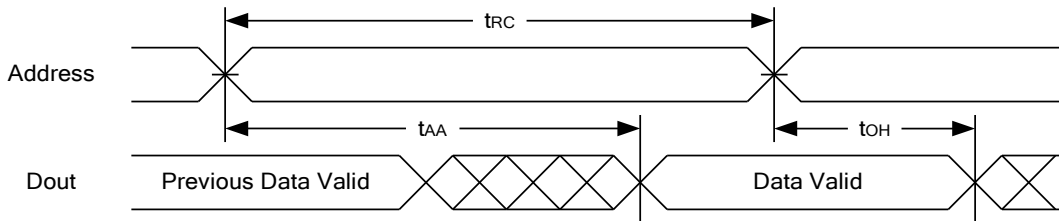
(2) WRITE CYCLE

PARAMETER	SYM.	AS6C1616C-45		UNIT
		MIN.	MAX.	
Write Cycle Time	t _{WC}	45	-	ns
Address Valid to End of Write	t _{AW}	40	-	ns
Chip Enable to End of Write	t _{CW}	40	-	ns
Address Set-up Time	t _{AS}	0	-	ns
Write Pulse Width	t _{WP}	35	-	ns
Write Recovery Time	t _{WR}	0	-	ns
Data to Write Time Overlap	t _{DW}	20	-	ns
Data Hold from End of Write Time	t _{DH}	0	-	ns
Output Active from End of Write	t _{OW} *	5	-	ns
Write to Output in High-Z	t _{WHZ} *	-	20	ns
LB#, UB# Valid to End of Write	t _{BW}	35	-	ns

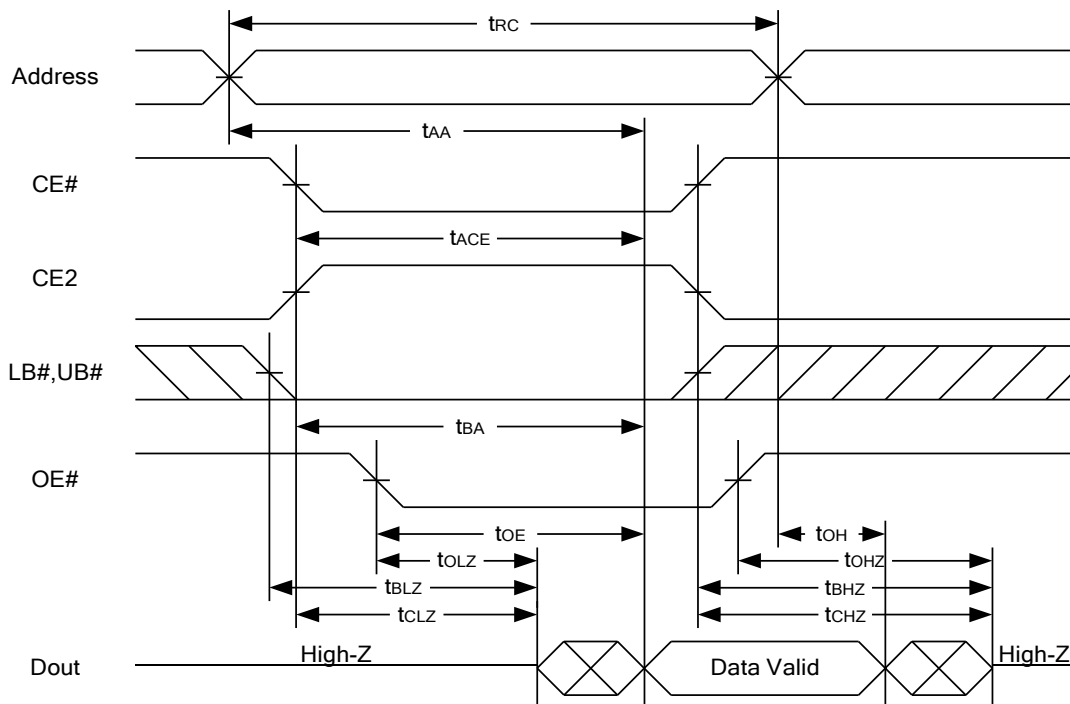
*These parameters are guaranteed by device characterization, but not production tested.

TIMING WAVEFORMS

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



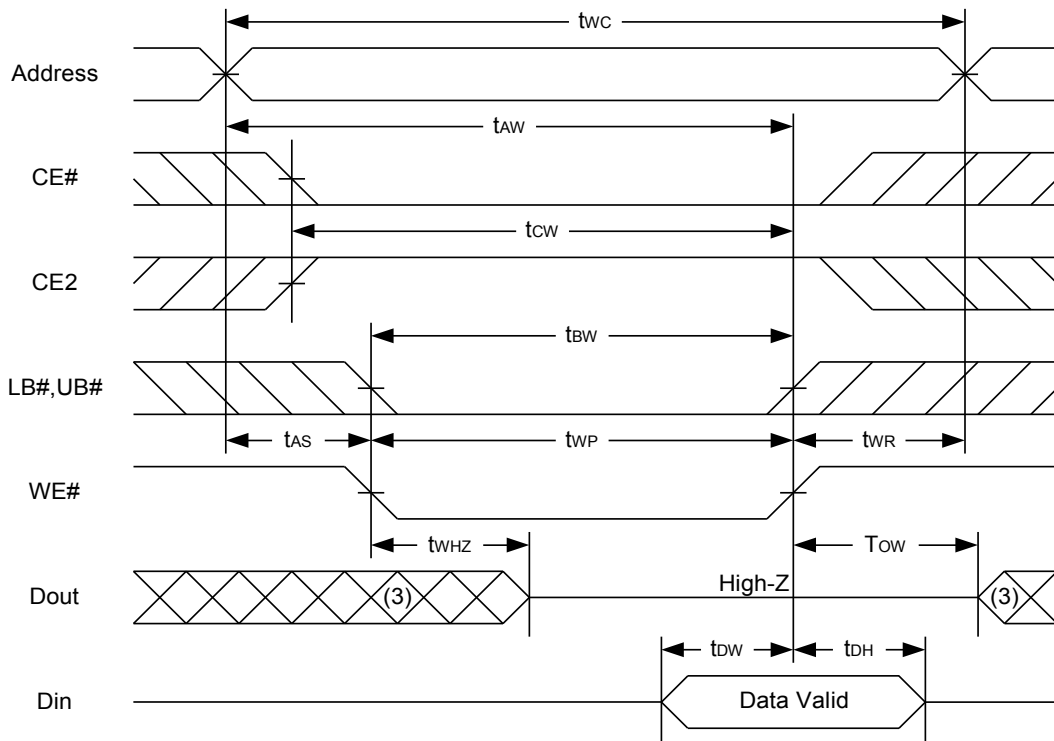
READ CYCLE 2 (CE# and CE2 and OE# Controlled) (1,3,4,5)



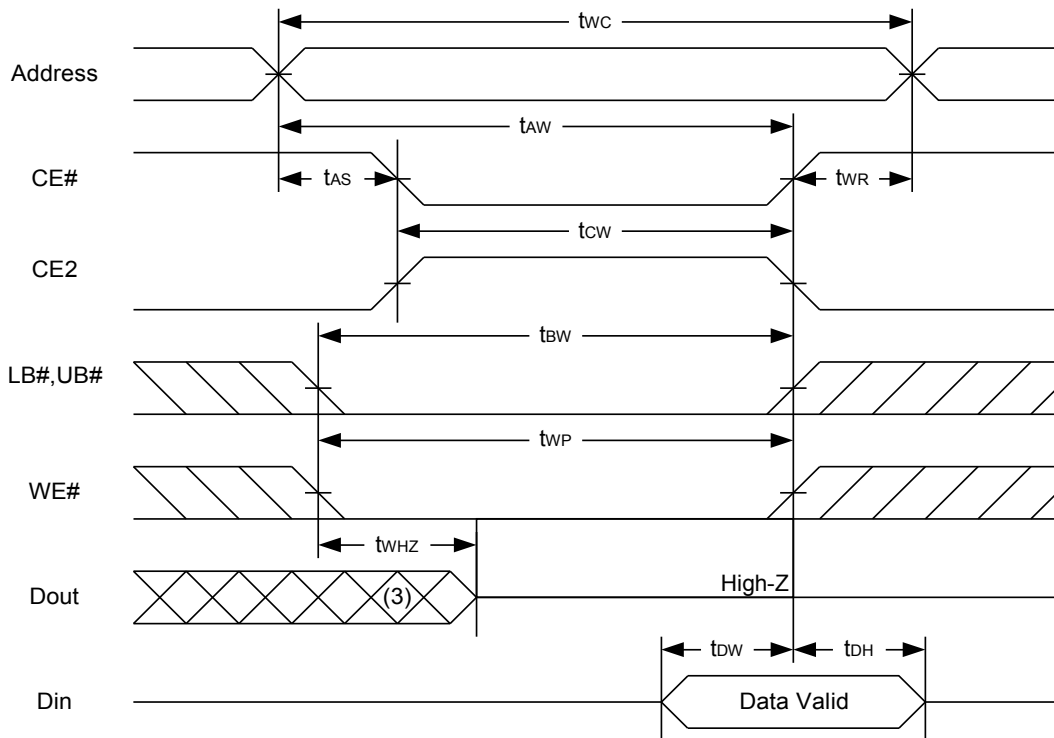
Notes :

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_{AA} is the limiting parameter.
4. t_{CLZ} , t_{BLZ} , t_{OLZ} , t_{CHZ} , t_{BHZ} and t_{OHZ} are specified with $C_L = 5\text{pF}$. Transition is measured $\pm 500\text{mV}$ from steady state.
5. At any given temperature and voltage condition, t_{CHZ} is less than t_{CLZ} , t_{BHZ} is less than t_{BLZ} , t_{OHZ} is less than t_{OLZ} .

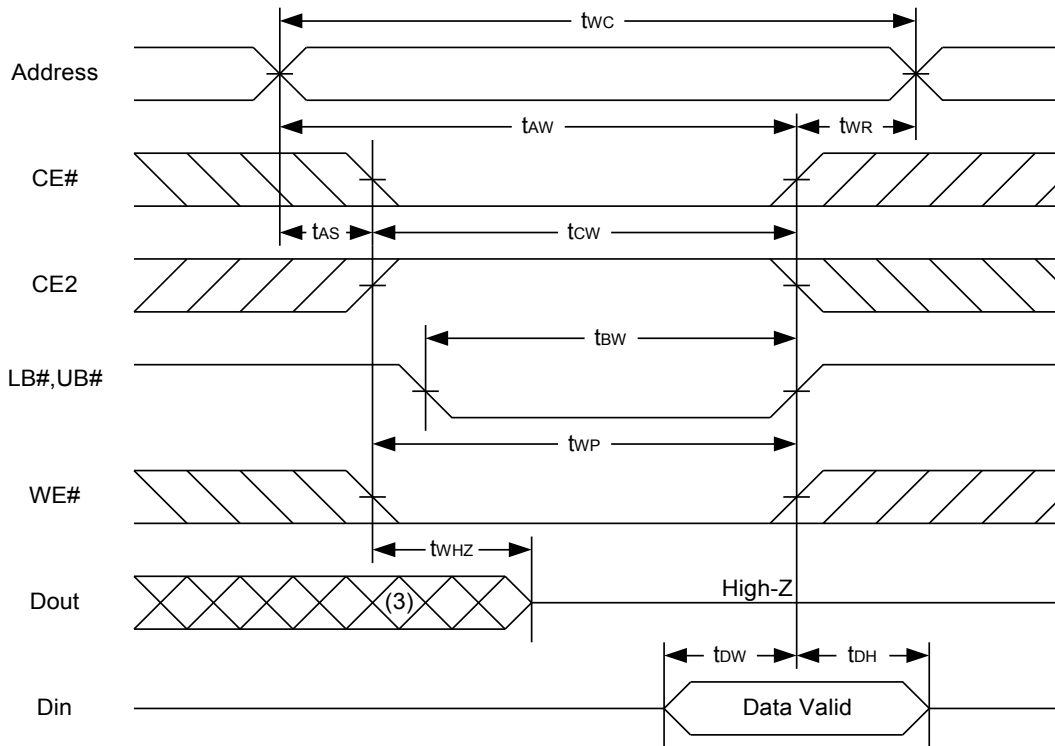
WRITE CYCLE 1 (WE# Controlled) (1,2,4,5)



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.

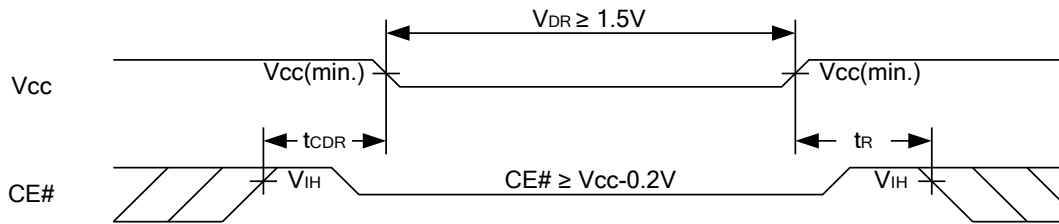
DATA RETENTION CHARACTERISTICS

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

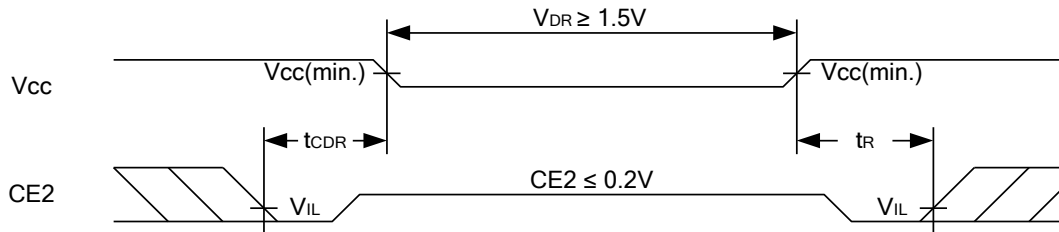
t_{RC}* = Read Cycle Time

DATA RETENTION WAVEFORM

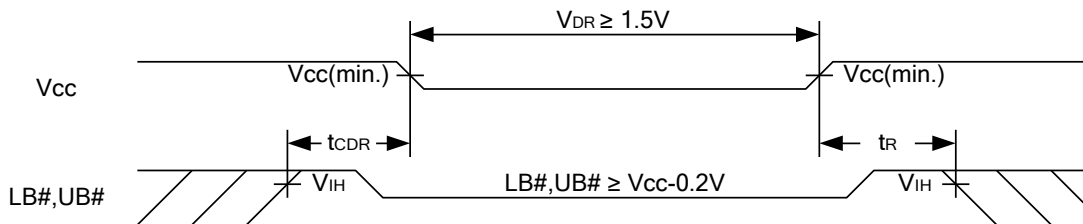
Low V_{CC} Data Retention Waveform (1) (CE# controlled)



Low V_{CC} Data Retention Waveform (2) (CE2 controlled)

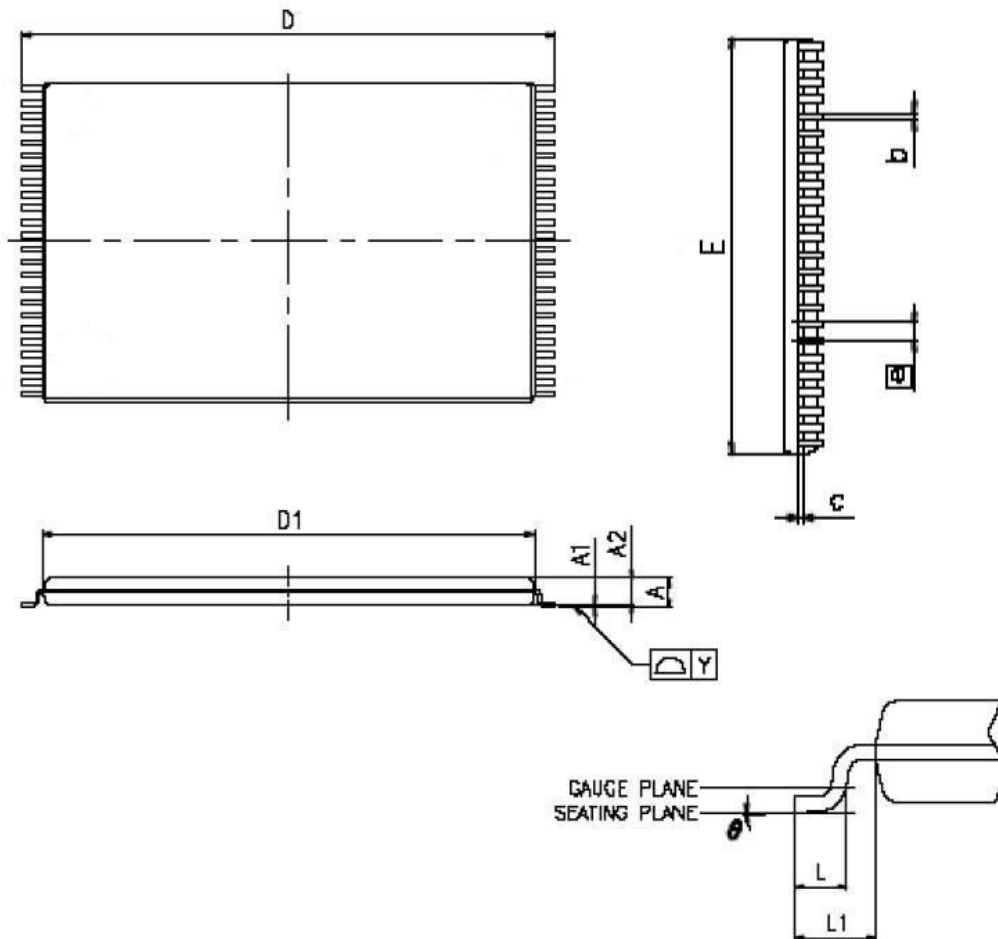


Low V_{CC} Data Retention Waveform (3) (LB#, UB# controlled)



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
Δ D	19.80	20.00	20.20
Δ D1	18.30	18.40	18.50
Δ E	11.90	12.00	12.10
\square	0.50 BASIC		
L	0.50	0.60	0.70
Δ L1	-	0.80	-
Δ Y	-	-	0.10
Δ θ	θ	-	5°

NOTES:

- JEDEC OUTLINE : MO-142 DD
- 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.
- 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.

ORDERING INFORMATION

Alliance Part Number	Organization	VCC Range	Package	Operating Temp	Speed ns
AS6C1616C-45TIN	1M×16/2M×8	2.7 ~ 3.6V	48pin 12mm x 20mm TSOP I	Industrial -40°C ~ 85°C	45

PART NUMBERING SYSTEM

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



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