



## Document Title

**256K x16 bit 1.7 ~ 2.3V Super Low Power FCMOS Slow SRAM**

## Revision History

<u>Revision No</u>	<u>History</u>	<u>Draft Date</u>	<u>Remark</u>
08	Icc1 Value change. 30mA -> 20mA	Nov.22.2000	Final
09	Marking Information add tBLZ / tOLZ value is changed Output Load is redefined Isb, Isb1, Vdr, Iccdr are redefined	Dec.18.2000	Final
10	Changed Logo	Mar.23.2001	Final
11	Changed Isb1 values	Jun.07.2001	Final

## DESCRIPTION

The HY62SF16403A is a high speed, super low power and 4Mbit full CMOS SRAM organized as 256K words by 16bits. The HY62SF16403A uses high performance full CMOS process technology and is designed for high speed and low power circuit technology. It is particularly well-suited for the high density low power system application. This device has a data retention mode that guarantees data to remain valid at a minimum power supply voltage of 1.2V.

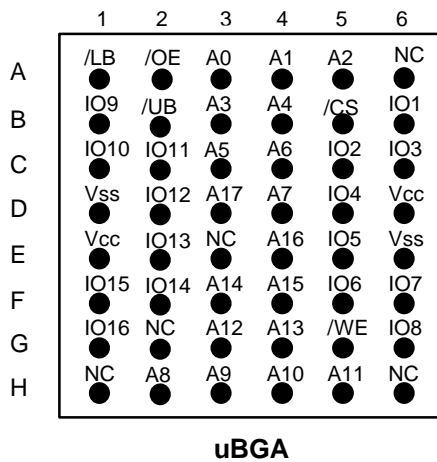
## FEATURES

- Fully static operation and Tri-state output
- TTL compatible inputs and outputs
- Battery backup
  - 1.2V(min) data retention
- Standard pin configuration
  - 48-ball uBGA

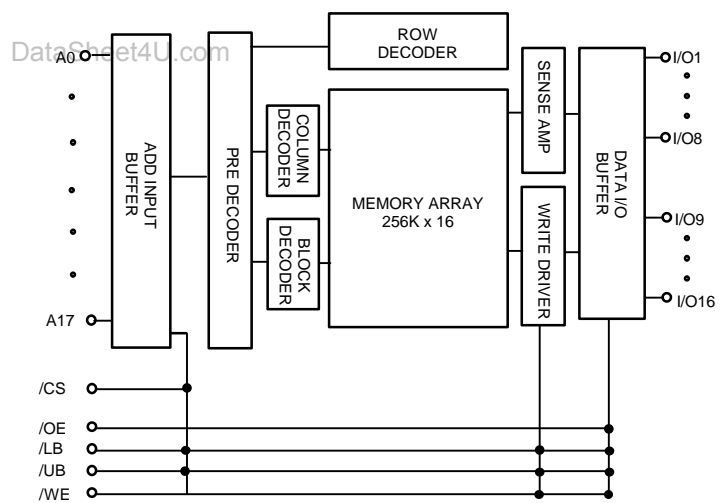
Product No.	Voltage (V)	Speed (ns)	Operation Current/I <sub>cc</sub> (mA)	Standby Current(μA)		Temperature (°C)
				LL	SL	
HY62SF16403A	1.7~2.3	85/100/120	3	10	3	0~70
HY62SF16403A-I	1.7~2.3	85/100/120	3	10	3	-40~85(I)

Note 1. Blank : Commercial, I : Industrial  
2. Current value is max.

## PIN CONNECTION



## BLOCK DIAGRAM



## PIN DESCRIPTION

Pin Name	Pin Function	Pin Name	Pin Function
/CS	Chip Select	I/O1~I/O16	Data Inputs/Outputs
/WE	Write Enable	A0~A17	Address Inputs
/OE	Output Enable	V <sub>cc</sub>	Power(1.7~2.3)
/LB	Lower Byte Control(I/O1~I/O8)	V <sub>ss</sub>	Ground
/UB	Upper Byte Control(I/O9~I/O16)	NC	No Connection

## ORDERING INFORMATION

Part No.	Speed	Power	Temp	Package
HY62SF16403ALLM	85/100/120	LL-part		uBGA
HY62SF16403ASLM	85/100/120	SL-part		uBGA
HY62SF16403ALLM-I	85/100/120	LL-part	I	uBGA
HY62SF16403ASLM-I	85/100/120	SL-part	I	uBGA

Note 1. Blank : Commercial, I : Industrial

## ABSOLUTE MAXIMUM RATINGS (1)

Symbol	Parameter	Rating	Unit	Remark
V <sub>IN</sub> , V <sub>OUT</sub>	Input/Output Voltage	-0.3 to 2.6	V	
V <sub>CC</sub>	Power Supply	-0.3 to 3.6	V	
T <sub>A</sub>	Operating Temperature	0 to 70	°C	HY62SF16403A
		-40 to 85	°C	HY62SF16403A-I
T <sub>STG</sub>	Storage Temperature	-55 to 150	°C	
P <sub>D</sub>	Power Dissipation	1.0	W	
T <sub>SOLDER</sub>	Ball Soldering Temperature & Time	260 • 10	°C•sec	

## Note

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is stress rating only and the functional operation of the device under these or any other conditions above those indicated in the operation of this specification is not implied. Exposure to the absolute maximum rating conditions for extended period may affect reliability.

## TRUTH TABLE

/CS	/WE	/OE	/LB	/UB	Mode	I/O Pin		Power
						I/O1~I/O8	I/O9~I/O16	
H	X	X	X	X	Deselected	High-Z	High-Z	Standby
X	X	X	H	H				
L	H	H	L	X	Output Disabled	High-Z	High-Z	Active
			X	L				
L	H	L	L	H	Read	DOUT	High-Z	Active
			H	L		High-Z	DOUT	
			L	L		DOUT	DOUT	
L	L	X	L	H	Write	DIN	High-Z	Active
			H	L		High-Z	DIN	
			L	L		DIN	DIN	

## Note:

- H=V<sub>IH</sub>, L=V<sub>IL</sub>, X=don't care (V<sub>IL</sub> or V<sub>IH</sub>)
- /UB, /LB(Upper, Lower Byte enable)  
These active LOW inputs allow individual bytes to be written or read.  
When /LB is LOW, data is written or read to the lower byte, I/O 1 -I/O 8.  
When /UB is LOW, data is written or read to the upper byte, I/O 9 -I/O 16.

## RECOMMENDED DC OPERATING CONDITION

Symbol	Parameter	Min.	Typ	Max.	Unit
V <sub>cc</sub>	Supply Voltage	1.7	1.8	2.3	V
V <sub>ss</sub>	Ground	0	0	0	V
V <sub>IH</sub>	Input High Voltage	1.4	-	V <sub>cc</sub> +0.3	V
V <sub>IL</sub>	Input Low Voltage	-0.3 <sup>1</sup>	-	0.4	V

Note : 1. Undershoot : V<sub>IL</sub> = -1.5V for pulse width less than 30ns  
 2. Undershoot is sampled, not 100% tested.

## DC ELECTRICAL CHARACTERISTICS

T<sub>A</sub> = 0°C to 70°C / -40°C to 85°C (I)

Sym	Parameter	Test Condition	Min	Typ <sup>1</sup>	Max	Unit
I <sub>LI</sub>	Input Leakage Current	V <sub>ss</sub> ≤ V <sub>IN</sub> ≤ V <sub>cc</sub>	-1	-	1	uA
I <sub>LO</sub>	Output Leakage Current	V <sub>ss</sub> ≤ V <sub>OUT</sub> ≤ V <sub>cc</sub> , /CS = V <sub>IH</sub> or /OE = V <sub>IH</sub> or /WE = V <sub>IL</sub> or /UB = V <sub>IH</sub> , /LB = V <sub>IH</sub>	-1	-	1	uA
I <sub>cc</sub>	Operating Power Supply Current	/CS = V <sub>IL</sub> , V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>I/O</sub> = 0mA			3	mA
I <sub>CC1</sub>	Average Operating Current	/CS = V <sub>IL</sub> , V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , Cycle Time = Min, 100% Duty, I <sub>I/O</sub> = 0mA			20	mA
		/CS ≤ 0.2V, V <sub>IN</sub> ≤ 0.2V or V <sub>IN</sub> ≥ V <sub>cc</sub> -0.2V, Cycle Time = 1us, 100% Duty, I <sub>I/O</sub> = 0mA			3	mA
I <sub>SB</sub>	Standby Current (TTL Input)	/CS = V <sub>IH</sub> or /UB, /LB = V <sub>IH</sub> V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>			0.3	mA
I <sub>SB1</sub>	Standby Current (CMOS Input)	/CS ≥ V <sub>cc</sub> - 0.2V or /UB, /LB ≥ V <sub>cc</sub> - 0.2V	SL	0.1	3	uA
		V <sub>IN</sub> ≥ V <sub>cc</sub> - 0.2V or V <sub>IN</sub> ≤ V <sub>ss</sub> + 0.2V	LL	0.1	10	uA
V <sub>OL</sub>	Output Low	I <sub>OL</sub> = 0.1mA	-	-	0.2	V
V <sub>OH</sub>	Output High	I <sub>OH</sub> = -0.1mA	1.6	-	-	V

Note

1. Typical values are at V<sub>cc</sub> = 1.8V T<sub>A</sub> = 25°C
2. Typical values are not 100% tested

## CAPACITANCE

(Temp = 25°C, f = 1.0MHz)

Symbol	Parameter	Condition	Max.	Unit
C <sub>IN</sub>	Input Capacitance(Add, /CS,/LB,/UB, /WE, /OE)	V <sub>IN</sub> = 0V	8	pF
C <sub>OUT</sub>	Output Capacitance(I/O)	V <sub>I/O</sub> = 0V	10	pF

Note : These parameters are sampled and not 100% tested

## AC CHARACTERISTICS

$T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$  /  $-40^\circ\text{C}$  to  $85^\circ\text{C}$  (I), unless otherwise specified

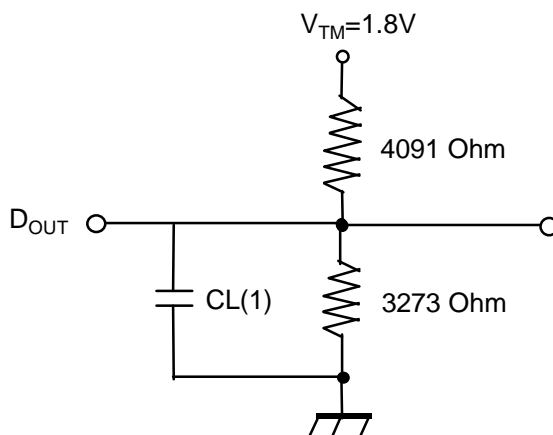
#	Symbol	Parameter	85ns		100ns		120ns		Unit
			Min.	Max.	Min.	Max.	Min	Max.	
READ CYCLE									
1	tRC	Read Cycle Time	85	-	100	-	120	-	ns
2	tAA	Address Access Time	-	85	-	100	-	120	ns
3	tACS	Chip Select Access Time	-	85	-	100	-	120	ns
4	tOE	Output Enable to Output Valid	-	40	-	50	-	60	ns
5	tBA	/LB, /UB Access Time	-	85	-	100	-	120	ns
6	tCLZ	Chip Select to Output in Low Z	10	-	10	-	10	-	ns
7	tOLZ	Output Enable to Output in Low Z	5	-	5	-	5	-	ns
8	tBLZ	/LB, /UB Enable to Output in Low Z	10	-	10	-	10	-	ns
9	tCHZ	Chip Deselection to Output in High Z	0	30	0	30	0	40	ns
10	tOHZ	Out Disable to Output in High Z	0	30	0	30	0	40	ns
11	tBHZ	/LB, /UB Disable to Output in High Z	0	30	0	30	0	40	ns
12	tOH	Output Hold from Address Change	10	-	15	-	15	-	ns
WRITE CYCLE									
13	tWC	Write Cycle Time	85	-	100	-	100	-	ns
14	tCW	Chip Selection to End of Write	70	-	80	-	100	-	ns
15	tAW	Address Valid to End of Write	70	-	80	-	100	-	ns
16	tBW	/LB, /UB Valid to End of Write	70	-	80	-	100	-	ns
17	tAS	Address Set-up Time	0	-	0	-	0	-	ns
18	tWP	Write Pulse Width	60	-	70	-	85	-	ns
19	tWR	Write Recovery Time	0	-	0	-	0	-	ns
20	tWHZ	Write to Output in High Z	0	25	0	30	0	35	ns
21	tDW	Data to Write Time Overlap	35	-	40	-	50	-	ns
22	tDH	Data Hold from Write Time	0	-	0	-	0	-	ns
23	tOW	Output Active from End of Write	5	-	10	-	10	-	ns

## AC TEST CONDITIONS

$T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$  /  $-40^\circ\text{C}$  to  $85^\circ\text{C}$  (I), unless otherwise specified

Parameter		Value
Input Pulse Level		0.4V to 1.6V
Input Rise and Fall Time		5ns
Input and Output Timing Reference Level		0.9V
Output Load	tCLZ, tOLZ, tBLZ, tCHZ, tOHZ, tBHZ, tWHZ, tOW	CL = 5pF + 1TTL Load
	Others	CL = 30pF + 1TTL Load

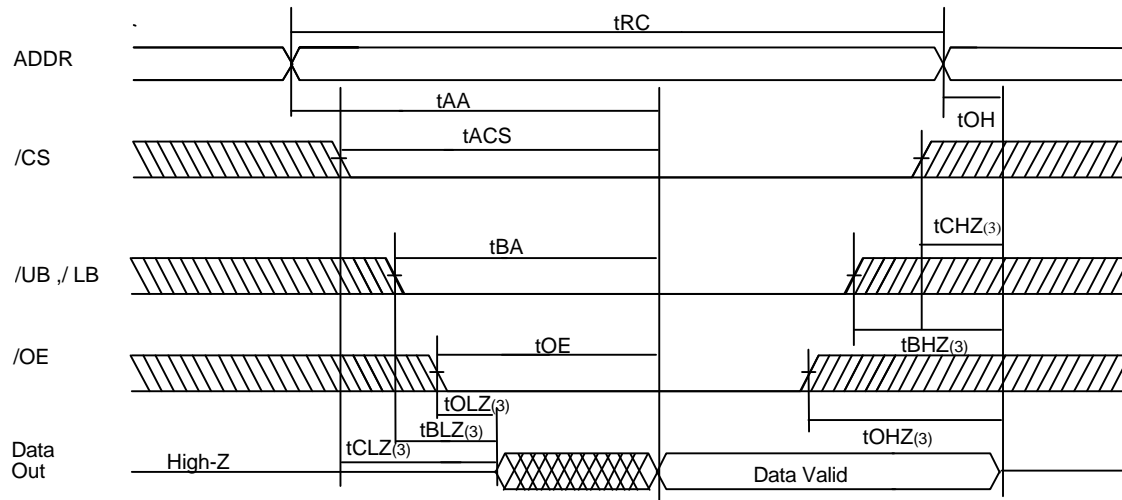
## AC TEST LOADS



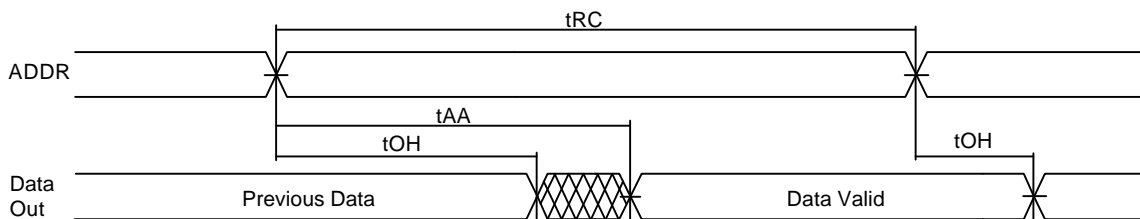
Note 1. Including jig and scope capacitance.

## TIMING DIAGRAM

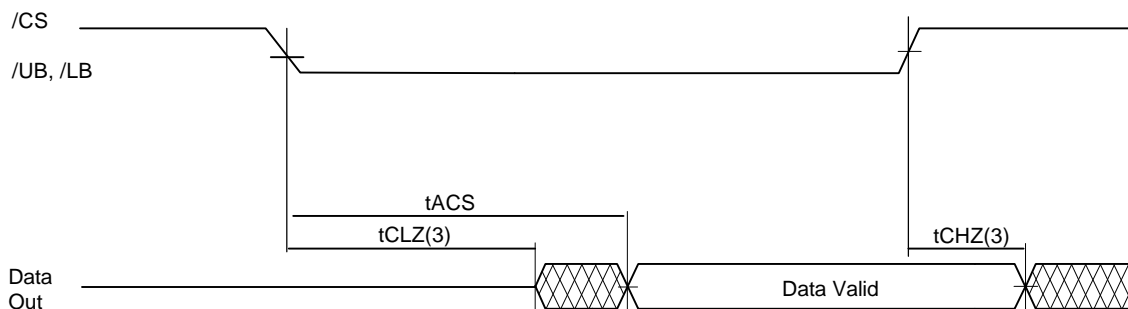
### READ CYCLE 1 (Note 1,4)



### READ CYCLE 2 (Note 1,2,4)



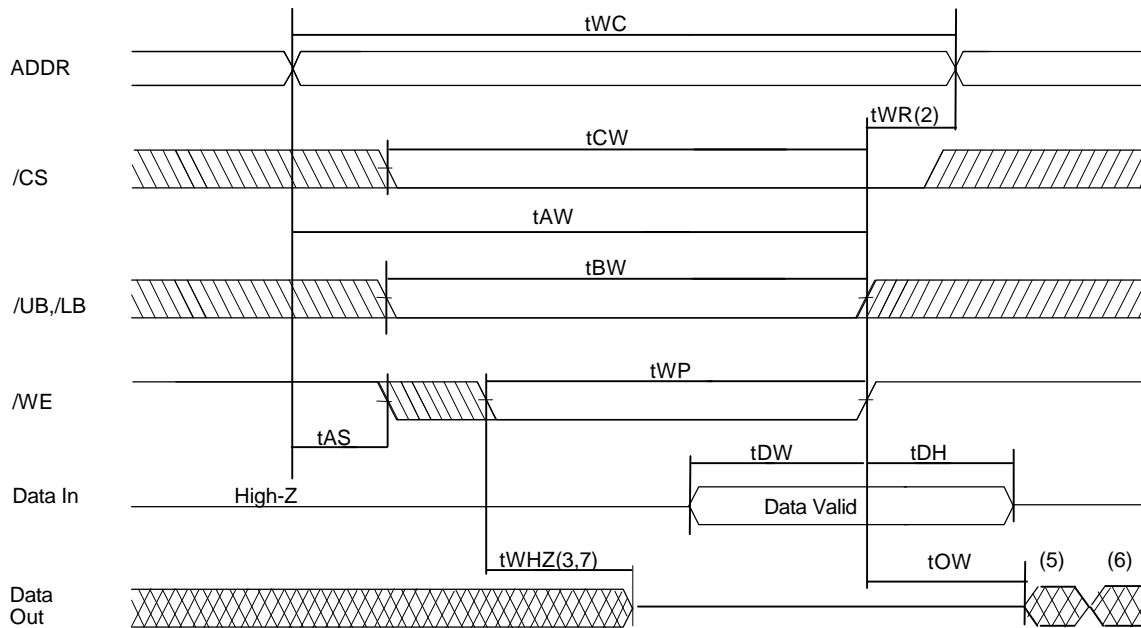
### READ CYCLE 3 (Note 1,2,4)



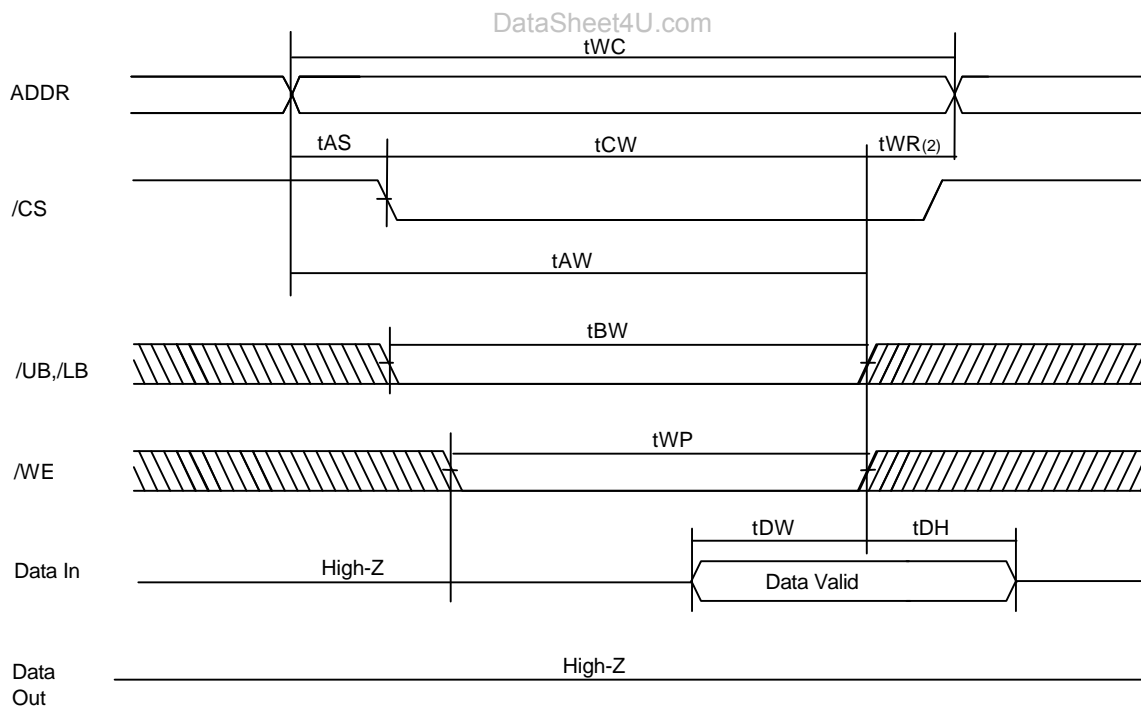
#### Notes:

1. A read occurs during the overlap of a low /OE, a high /WE, a low /CS and /UB and/or /LB .
2. /OE =  $V_{IL}$
3. Transition is measured  $\pm 200mV$  from steady state voltage.  
This parameter is sampled and not 100% tested.
4. /CS in high for the standby, low for active  
/UB and /LB in high for the standby, low for active

WRITE CYCLE 1 (1,4,8) (/WE Controlled)



WRITE CYCLE 2 (Note 1,4,8) (/CS Controlled)



## Notes:

1. A write occurs during the overlap of a low /WE, a low /CS and a low /UB and/or /LB .
2. tWR is measured from the earlier of /CS, /LB, /UB, or /WE going high to the end of write cycle.
3. During this period, I/O pins are in the output state so that the input signals of opposite phase to the output must not be applied.
4. If the /CS, /LB and /UB low transition occur simultaneously with the /WE low transition or after the /WE transition, outputs remain in a high impedance state.
5. Q(data out) is the same phase with the write data of this write cycle.
6. Q(data out) is the read data of the next address.
7. Transition is measured  $\pm 200\text{mV}$  from steady state.  
This parameter is sampled and not 100% tested.
8. /CS in high for the standby, low for active  
/UB and /LB in high for the standby, low for active

## DATA RETENTION ELECTRIC CHARACTERISTIC

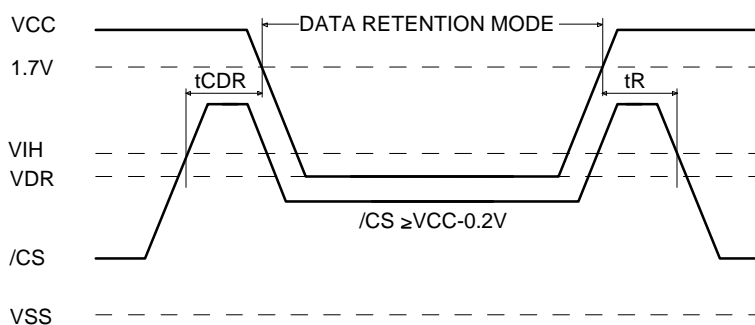
 $T_A=0^\circ\text{C}$  to  $70^\circ\text{C}$  /  $-40^\circ\text{C}$  to  $85^\circ\text{C}$  (I)

Symbol	Parameter	Test Condition	Min	Typ <sup>1</sup>	Max	Unit	
VDR	Vcc for Data Retention	/CS $\geq$ Vcc - 0.2V or /UB, /LB $\geq$ Vcc - 0.2V	1.2	-	2.3	V	
Iccdr	Data Retention Current	Vcc=1.5V, /CS $\geq$ Vcc - 0.2V or /UB, /LB $\geq$ Vcc - 0.2V VIN $\geq$ Vcc - 0.2V or VIN $\leq$ Vss + 0.2V	SL	-	0.1	3	$\mu\text{A}$
			LL	-	0.1	10	$\mu\text{A}$
tCDR	Chip Deselect to Data Retention Time	See Data Retention Timing Diagram	0	-	-	ns	
tR	Operating Recovery Time		tRC	-	-	ns	

## Notes:

1. Typical values are under the condition of  $T_A = 25^\circ\text{C}$ .
2. Typical value are sampled and not 100% tested

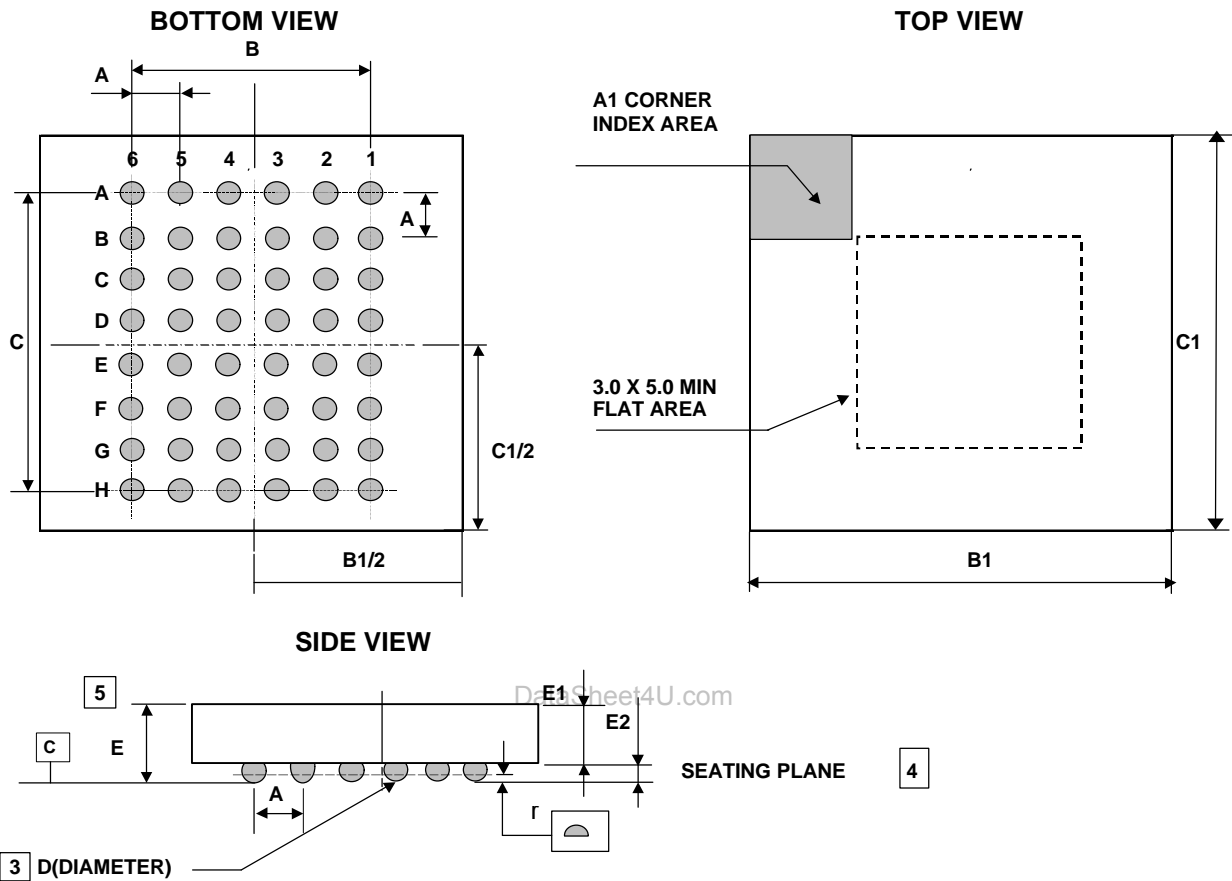
## DATA RETENTION TIMING DIAGRAM





## PACKAGE INFORMATION

48ball Micro Ball Grid Array Package(M)

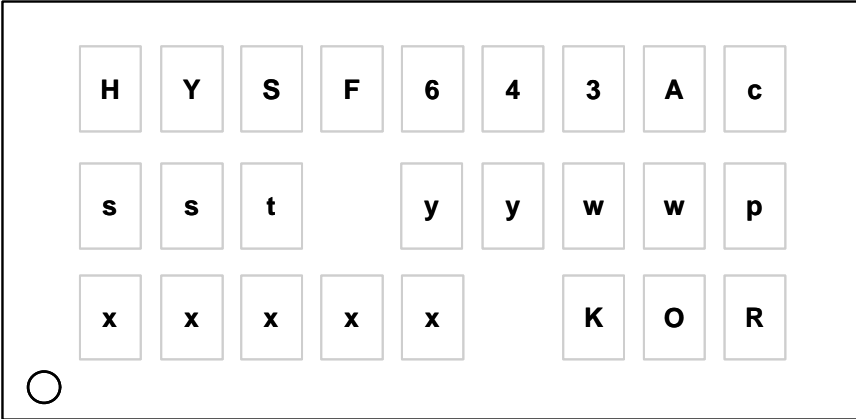


Symbol	Min.	Typ.	Max.
A	-	0.75	-
B	-	3.75	-
B1	8.3	8.4	8.5
C	-	5.25	-
C1	7.1	7.2	7.3
D	0.3	0.35	0.4
E	0.85	0.9	0.95
E1	0.6	0.65	0.7
E2	0.2	0.25	0.3
r	-	-	0.08

### Note

1. DIMENSIONING AND TOLERANCING PER ASME Y14. 5M-1994.
2. ALL DIMENSIONS ARE MILLIMETERS.
3. DIMENSION "D" IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER IN A PLANE PARALLEL TO DATUM C.
4. PRIMARY DATUM C(SEATING PLANE) IS DEFINED BY THE CROWN OF THE SOLDER BALLS.
5. THIS IS A CONTROLLING DIMENSION.

## MARKING INFORMATION

Package	Marking Example
uBGA	
Index	
<ul style="list-style-type: none"> <li>• <b>HYSF643A</b></li> <li>• <b>c</b></li> <li>• <b>ss</b></li> <li>• <b>t</b></li> <li>• <b>yy</b></li> <li>• <b>ww</b></li> <li>• <b>p</b></li> <li>• <b>xxxxx</b></li> <li>• <b>KOR</b></li> </ul> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>- Capital Letter</li> <li>- Small Letter</li> </ul>	<ul style="list-style-type: none"> <li>: Part Name</li> <li>: Power Consumption               <ul style="list-style-type: none"> <li>- L : Low Low Power</li> <li>- S : Super Low Power</li> </ul> </li> <li>: Speed               <ul style="list-style-type: none"> <li>- 85 : 85ns</li> <li>- 10 : 100ns</li> <li>- 12 : 120ns</li> </ul> </li> <li>: Temperature               <ul style="list-style-type: none"> <li>- C : Industrial ( -0 ~ 70 °C )</li> <li>- I : Industrial ( -40 ~ 85 °C )</li> </ul> </li> <li>: Year ( ex : 00 = year 2000, 01= year 2001 )</li> <li>: Work Week ( ex : 12 = work week 12 )</li> <li>: Process Code</li> <li>: Lot No.</li> <li>: Origin Country</li> </ul> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>: Fixed Item</li> <li>: Non-fixed Item</li> </ul>