

## Document Title

128K x16 bit 3.0V Super Low Power Full CMOS Slow SRAM

## Revision History

<u>Revision No</u>	<u>History</u>	<u>Draft Date</u>	<u>Remark</u>
05	Divide output load into two factors - tCLZ,tOLZ,tBLZ,tCHZ,tOHZ,tBHZ,tWHZ,tOW - Others	Dec.10. 2000	Final
06	Add the marking information Correct the PKG dimension(E1)	Aug. 01. 2001	
07	Add the dimension and the marking information of the 6x8 PKG size Separate the part number(HY62UF16201AF1) for the 6x8 PKG size from the 7x8 PKG size(HY62UF16201AF)	Aug. 31. 2001	

## DESCRIPTION

The HY62UF16201A is a high speed, super low power and 2Mbit full CMOS SRAM organized as 131,072 words by 16bits. The HY62UF16201A 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

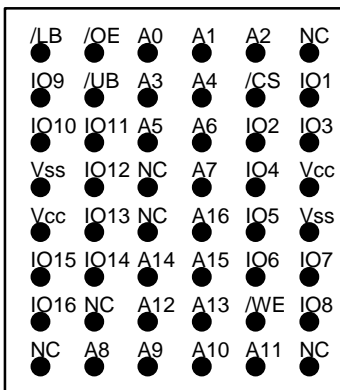
- Fully static operation and Tri-state output
- TTL compatible inputs and outputs
- Battery backup(LL/SL-part)
  - . 1.2V(min) data retention
- Standard pin configuration
  - . 48-FBGA

Product No.	Voltage (V)	Speed (ns)	Operation Current/I <sub>cc</sub> (mA)	Standby Current(uA)		Temperature (°C)
				LL	SL	
HY62UF16201A	2.7~3.3	55/70/85/100	3	10	2	0~70
HY62UF16201A-I	2.7~3.3	55/70/85/100	3	10	2	-40~85(I)

Notes :

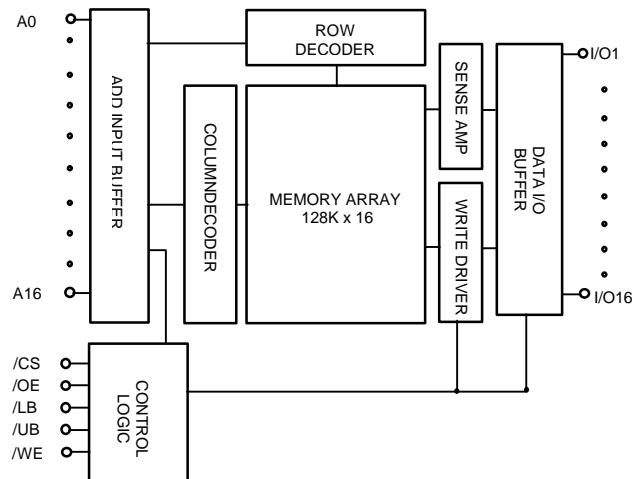
1. Blank : Commercial, I : Industrial
2. Current value is max.

## PIN CONNECTION



48-FBGA(Top View)

## 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~A16	Address Inputs
/OE	Output Enable	V <sub>cc</sub>	Power(2.7V~3.3V)
/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
HY62UF16201ALLF	55/70/85/100	LL-part		FBGA(7mm X 8mm)
HY62UF16201ALLF-I	55/70/85/100	LL-part	I	FBGA(7mm X 8mm)
HY62UF16201ASLF	55/70/85/100	SL-part		FBGA(7mm X 8mm)
HY62UF16201ASLF-I	55/70/85/100	SL-part	I	FBGA(7mm X 8mm)
HY62UF16201ALLF1	55/70/85/100	LL-part		FBGA(6mm X 8mm)
HY62UF16201ALLF1-I	55/70/85/100	LL-part	I	FBGA(6mm X 8mm)
HY62UF16201ASLF1	55/70/85/100	SL-part		FBGA(6mm X 8mm)
HY62UF16201ASLF1-I	55/70/85/100	SL-part	I	FBGA(6mm X 8mm)

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	-0.2 to 3.6	V	
V <sub>CC</sub>	Power Supply	-0.2 to 4.6	V	
T <sub>A</sub>	Operating Temperature	0 to 70	°C	HY62UF16201A
		-40 to 85	°C	HY62UF16201A-I
T <sub>STG</sub>	Storage Temperature	-55 to 150	°C	
P <sub>D</sub>	Power Dissipation	1.0	W	
T <sub>SD</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		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	Deselected	High-Z	High-Z	Standby
L	H	H	L	X	Output Disabled	High-Z	High-Z	Active
L	H	H	X	L	Output Disabled	High-Z	High-Z	Active
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 :

1. H=V<sub>IH</sub>, L=V<sub>IL</sub>, X=don't care

2. 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	2.7	3.0	3.3	V
V <sub>SS</sub>	Ground	0	0	0	V
V <sub>IH</sub>	Input High Voltage	2.2	-	V <sub>CC</sub> +0.3	V
V <sub>IL</sub>	Input Low Voltage	-0.3(1)	-	0.6	V

Note :

1. V<sub>IL</sub> = -1.5V for pulse width less than 30ns

## DC ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	Test Condition	Min.	Typ.	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> , /UB = /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	Cycle Time=Min.100% duty, /CS = V <sub>IL</sub> , V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>I/O</sub> = 0mA	-	-	45	mA	
		Cycle time = 1us, /CS ≤ 0.2V, V <sub>IN</sub> < 0.2V, I <sub>I/O</sub> = 0mA	-	-	5	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, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V or V <sub>IN</sub> ≤ V <sub>SS</sub> + 0.2V	SL	-	-	2	uA
			LL	-	0.5	10	uA
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1mA	-	-	0.4	V	
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -1.0mA	2.4	-	-	V	

Notes :

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

## CAPACITANCE

(Temp = 25°C, f = 1.0MHz)

Symbol	Parameter	Condition	Max.	Unit
C <sub>IN</sub>	Input Capacitance(Add, /CS, /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 :

1. These parameters are sampled and not 100% tested

**AC CHARACTERISTICS**

TA=0°C to 70°C/ -40°C to 85°C (I), unless otherwise specified

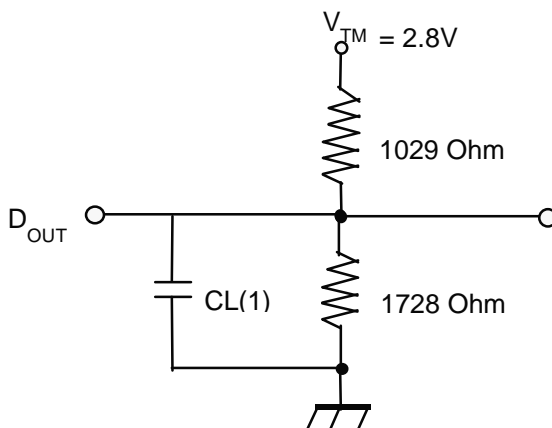
#	Symbol	Parameter	-55		-70		-85		-10		Unit
			Min	Max	Min	Max	Min	Max	Min	Max	
READ CYCLE											
1	tRC	Read Cycle Time	55	-	70	-	85	-	100	-	ns
2	tAA	Address Access Time	-	55	-	70	-	85	-	100	ns
3	tACS	Chip Select Access Time	-	55	-	70	-	85	-	100	ns
4	tOE	Output Enable to Output Valid	-	30	-	35	-	40	-	50	ns
5	tBA	/LB, /UB Access Time	-	55	-	70	-	85	-	100	ns
6	tCLZ	Chip Select to Output in Low Z	10	-	10	-	10	-	20	-	ns
7	tOLZ	Output Enable to Output in Low Z	5	-	5	-	5	-	5	-	ns
8	tBLZ	/LB, /UB Enable to Output in Low Z	5	-	5	-	5	-	5	-	ns
9	tCHZ	Chip Deselection to Output in High Z	0	30	0	30	0	30	0	30	ns
10	tOHZ	Out Disable to Output in High Z	0	30	0	30	0	30	0	30	ns
11	tBHZ	/LB, /UB Disable to Output in High Z	0	30	0	30	0	30	0	30	ns
12	tOH	Output Hold from Address Change	10	-	10	-	10	-	15	-	ns
WRITE CYCLE											
13	tWC	Write Cycle Time	55	-	70	-	85	-	100	-	ns
14	tCW	Chip Selection to End of Write	50	-	60	-	70	-	80	-	ns
15	tAW	Address Valid to End of Write	50	-	60	-	70	-	80	-	ns
16	tBW	/LB, /UB Valid to End of Write	50	-	60	-	70	-	80	-	ns
17	tAS	Address Set-up Time	0	-	0	-	0	-	0	-	ns
18	tWP	Write Pulse Width	45	-	50	-	55	-	75	-	ns
19	tWR	Write Recovery Time	0	-	0	-	0	-	0	-	ns
20	tWHZ	Write to Output in High Z	0	20	0	25	0	30	0	35	ns
21	tDW	Data to Write Time Overlap	25	-	30	-	35	-	45	-	ns
22	tDH	Data Hold from Write Time	0	-	0	-	0	-	0	-	ns
23	tOW	Output Active from End of Write	5	-	5	-	5	-	10	-	ns

**AC TEST CONDITIONS**

TA = 0°C to 70°C/ -40°C to 85°C (I), unless otherwise specified

Parameter	Value
Input Pulse Level	0.4V to 2.2V
Input Rise and Fall Time	5ns
Input and Output Timing Reference Level	1.5V
Output Load	tCLZ,tOLZ,tBLZ,tCHZ,tOHZ,tBHZ,tWHZ,tOW
	Others
	CL = 5pF + 1TTL Load
	CL = 30pF + 1TTL Load

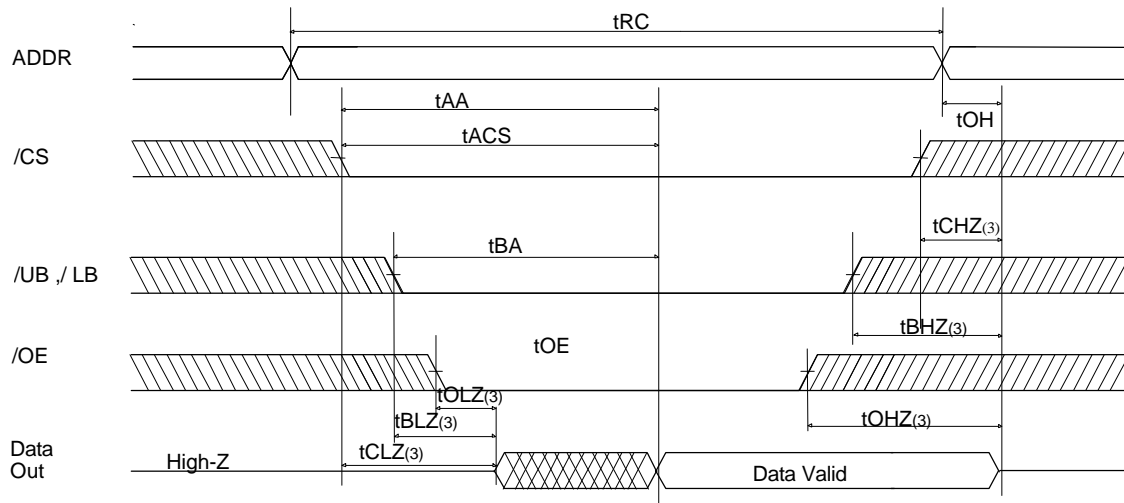
**AC TEST LOADS**



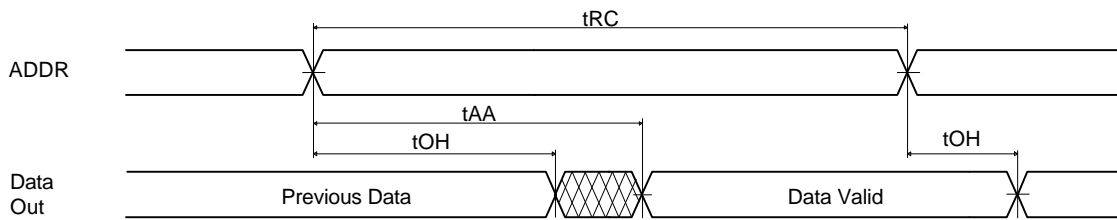
Note :  
1. Including jig and scope capacitance

**TIMING DIAGRAM**

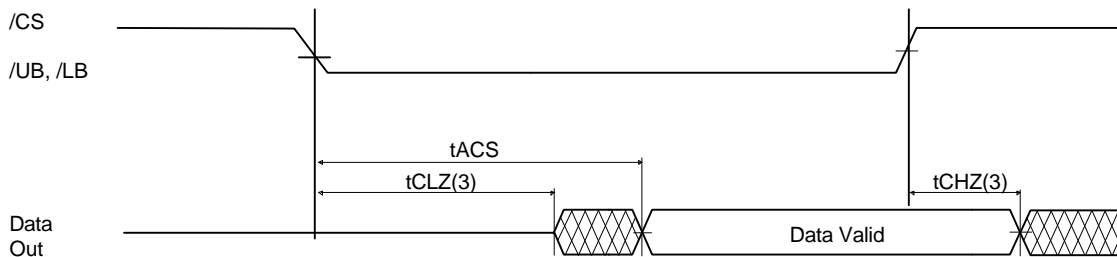
READ CYCLE 1(Note 1,4)



READ CYCLE 2(Note 2,3,4)



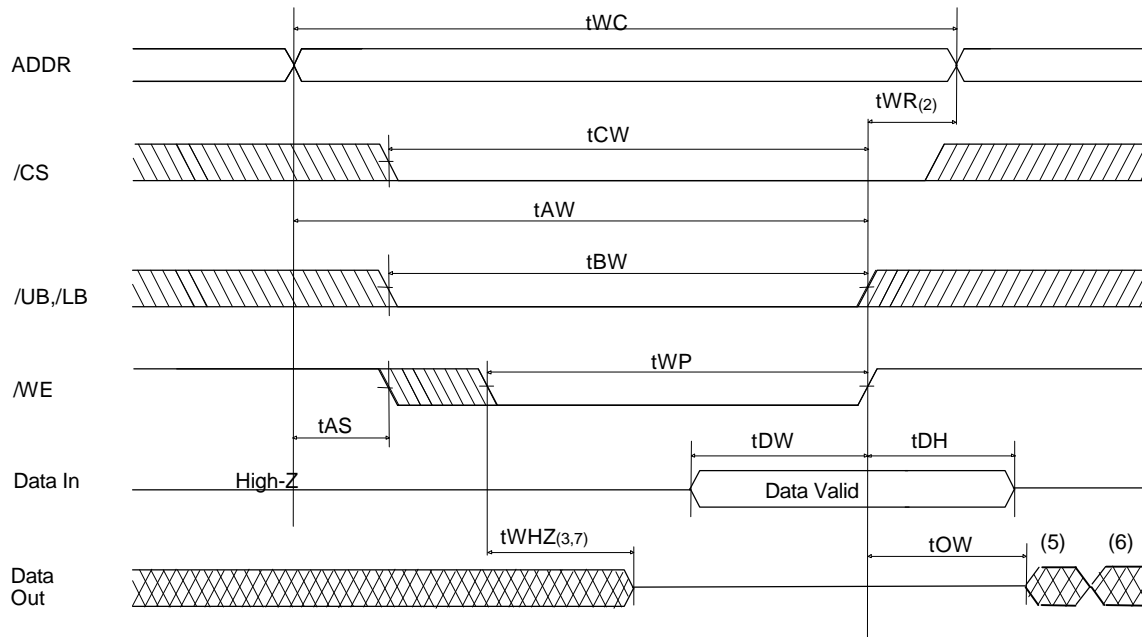
READ CYCLE 3(Note 1,2,4)



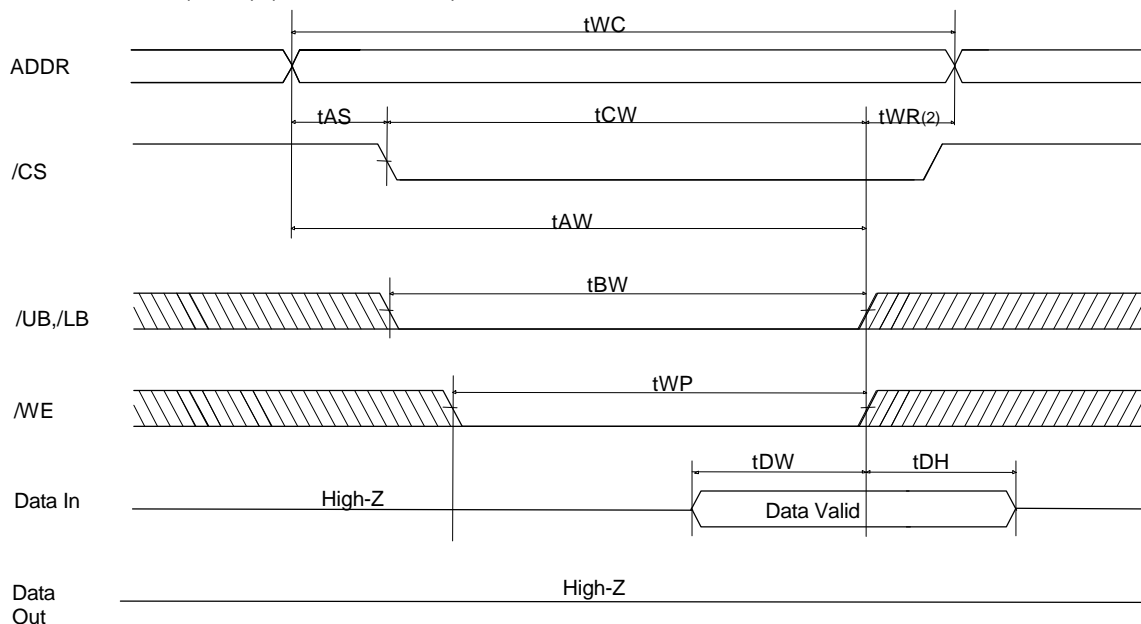
Notes:

- A read occurs during the overlap of a low /OE, a high /WE, a low /CS1 and low /UB and/or /LB.
- 2. /OE = V<sub>IL</sub>
- 3. Transition is measured ± 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 (1,4,8) (/CS Controlled)



Notes:

1. A write occurs during the overlap of a low /WE, a low /CS1 and low /UB and/or /LB.
2.  $t_{WR}$  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 +200mV 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**

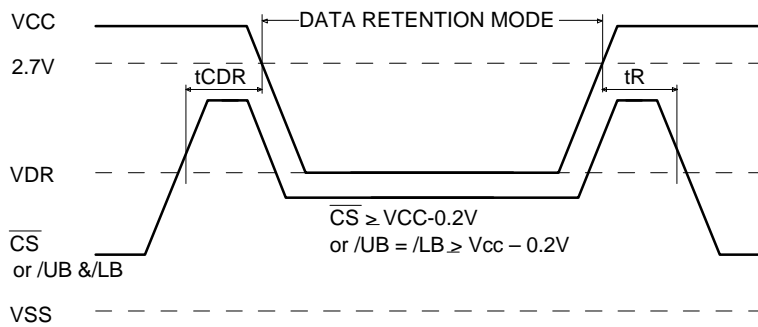
TA=0°C to 70°C/ -40°C to 85°C (I), unless otherwise specified

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit	
VDR	Vcc for Data Retention	/CS ≥ Vcc - 0.2V or /UB = /LB ≥ Vcc-0.2V, VIN ≥ Vcc - 0.2V or VIN ≤ Vss + 0.2V	1.2	-	3.3	V	
ICCDR	Data Retention Current	Vcc=1.5V, /CS ≥ Vcc - 0.2V or /UB = /LB ≥ Vcc-0.2V, VIN ≥ Vcc - 0.2V or VIN ≤ Vss + 0.2V	LL	-	-	10	uA
			SL	-	-	2	uA
tCDR	Chip Deselect to Data Retention Time	See Data Retention Timing Diagram	0	-	-	ns	
tR	Operating Recovery Time		tRC(3)	-	-	ns	

Notes:

1. Typical values are under the condition of TA = 25°C.
2. Typical Values are sampled and not 100% tested
3. tRC is read cycle time.

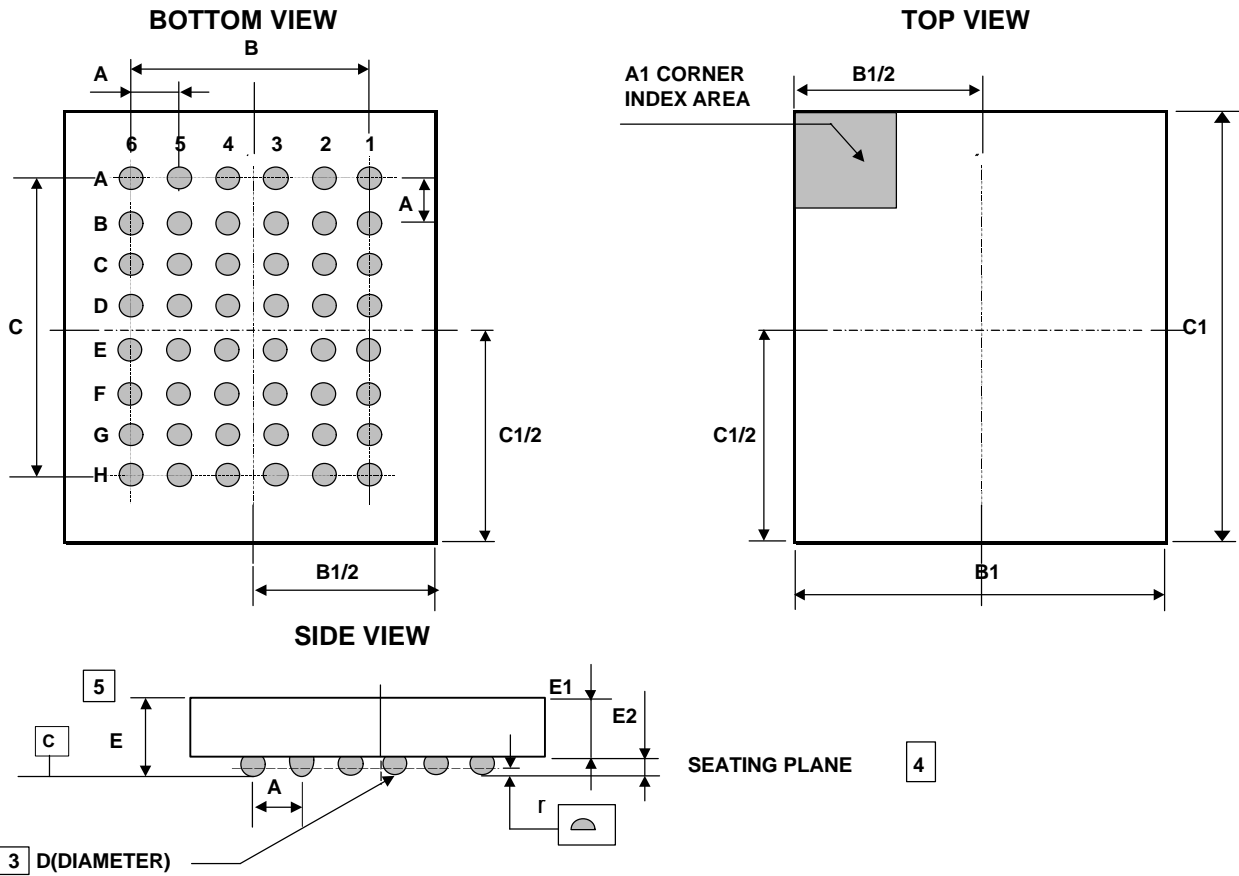
**DATA RETENTION TIMING DIAGRAM**





**PACKAGE INFORMATION**

48ball Fine Pitch Ball Grid Array Package(F)



[ HY62UF16201AF ]

Symbol	Min.	Typ.	Max.
A	-	0.75	-
B	-	3.75	-
B1	6.90	7.00	7.10
C	-	5.25	-
C1	7.90	8.00	8.10
D	0.3	0.35	0.4
E	-	-	1.10
E1	0.75	0.80	0.85
E2	0.17	-	-
r	-	-	0.12

[ HY62UF16201AF1 ]

Min.	Typ.	Max.
-	0.75	-
-	3.75	-
5.90	6.00	6.10
-	5.25	-
7.90	8.00	8.10
0.3	0.35	0.4
-	1.0	1.10
-	0.75	-
0.2	0.25	0.3
-	-	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 INSTRUCTION**

**[ HY62UF16201AF ]**

Package	Marking Example																											
<b>FBGA</b> (7mm x 8mm)	<table border="1" style="margin: auto;"> <tr> <td>H</td><td>Y</td><td>U</td><td>F</td><td>6</td><td>2</td><td>1</td><td>A</td><td>c</td> </tr> <tr> <td>s</td><td>s</td><td>t</td><td></td><td>y</td><td>y</td><td>w</td><td>w</td><td>p</td> </tr> <tr> <td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td></td><td>K</td><td>O</td><td>R</td> </tr> </table> <div style="text-align: left; margin-top: 10px;">○</div>	H	Y	U	F	6	2	1	A	c	s	s	t		y	y	w	w	p	x	x	x	x	x		K	O	R
H	Y	U	F	6	2	1	A	c																				
s	s	t		y	y	w	w	p																				
x	x	x	x	x		K	O	R																				

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<ul style="list-style-type: none"> <li>• <b>HYUF621Ac</b> : Part Name</li> <li>• <b>c</b> : Power Consumption                             <ul style="list-style-type: none"> <li>- L : Low Low Power</li> <li>- S : Super Low Power</li> </ul> </li> <li>• <b>ss</b> : Speed                             <ul style="list-style-type: none"> <li>- 55 : 55ns</li> <li>- 70 : 70ns</li> <li>- 85 : 85ns</li> <li>- 10 : 100ns</li> </ul> </li> <li>• <b>t</b> : Temperature                             <ul style="list-style-type: none"> <li>- C : Industrial ( -0 ~ 70 °C )</li> <li>- I : Industrial ( -40 ~ 85 °C )</li> </ul> </li> <li>• <b>yy</b> : Year ( ex : 00 = year 2000, 01= year 2001 )</li> <li>• <b>ww</b> : Work Week ( ex : 12 = work week 12 )</li> <li>• <b>p</b> : Process Code : <b>A(7.0mm X 8.0mm)</b></li> <li>• <b>xxxxx</b> : Lot No.</li> <li>• <b>KOR</b> : Origin Country</li> </ul>	
<p><b>Note</b></p> <ul style="list-style-type: none"> <li>- Capital Letter : Fixed Item</li> <li>- Small Letter : Non-fixed Item</li> </ul>	

[ HY62UF16201AF1 ]

Package	Marking Example
<p style="text-align: center;"><b>FBGA</b> (6mm x 8mm)</p>	

**Index**

• <b>HYUF621Ac</b>	: Part Name
<b>c</b>	: Power Consumption
	- L : Low Low Power
	- S : Super Low Power
• <b>ss</b>	: Speed
	- 55 : 55ns
	- 70 : 70ns
	- 85 : 85ns
	- 10 : 100ns
• <b>t</b>	: Temperature
	- C : Industrial ( -0 ~ 70 °C )
	- I : Industrial ( -40 ~ 85 °C )
• <b>yy</b>	: Year ( ex : 01 = year 2001, 02= year 2002 )
• <b>ww</b>	: Work Week ( ex : 12 = work week 12 )
• <b>p</b>	: Process Code : <b>B(6.0mm X 8.0mm)</b>
• <b>xxxxx</b>	: Lot No.
• <b>KOR</b>	: Origin Country
<b>Note</b>	
- Capital Letter	: Fixed Item
- Small Letter	: Non-fixed Item