

Document Title

**256K x16 bit 2.7 ~ 3.3V Super Low Power FC MOS Slow SRAM**

Revision History

<u>Revision No</u>	<u>History</u>	<u>Draft Date</u>	<u>Remark</u>
00	Initial Draft	Dec.20.2001	Preliminary
01	Package Height Changed 1.0mm -> 0.9mm	Mar.05.2002	Preliminary
02	Add Package Size Option (6.0mmx8.0mm)	Feb.18.2003	Final

## DESCRIPTION

The HY62UF16404E is a high speed, super low power and 4Mbit full CMOS SRAM organized as 256K words by 16bits. The HY62UF16404E 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.

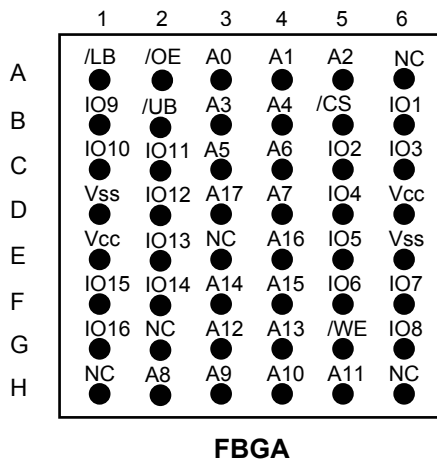
- Fully static operation and Tri-state output
- TTL compatible inputs and outputs
- Battery backup
  - 1.2V(min) data retention
- Standard pin configuration
  - 48-ball FBGA

## FEATURES

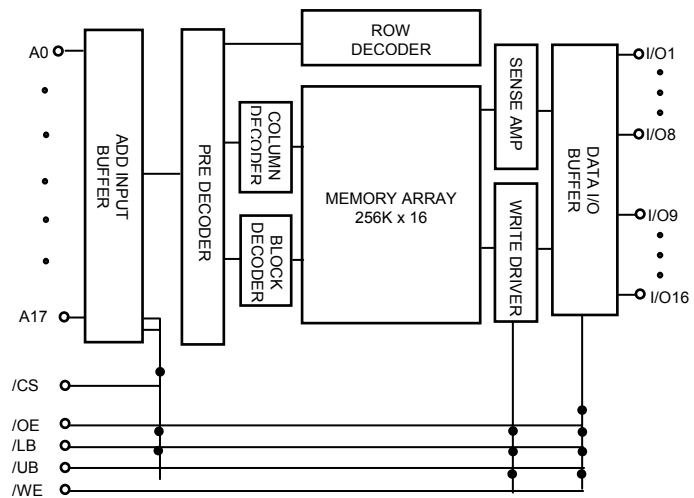
Product No.	Voltage (V)	Speed (ns)	Operation Current/I <sub>cc</sub> (mA)	Standby Current(μA)		Temperature (°C)
				SL	LL	
HY62UF16404E-I	2.7~3.3	55/70	3	6	10	-40~85

Note 1. 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	Vcc	Power (2.7~3.3V)
/LB	Lower Byte Control (I/O1~I/O8)	Vss	Ground
/UB	Upper Byte Control (I/O9~I/O16)	NC	No Connection

**ORDERING INFORMATION**

Part No.	Speed	Power	Temp'	Package
HY62UF16404E-SF(I)	55/70	SL-part	I	FBGA
HY62UF16404E-DF(I)	55/70	LL-part	I	FBGA

Note 1. 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 V <sub>CC</sub> +0.3V	V	
V <sub>CC</sub>	Power Supply	-0.3 to 3.6	V	
T <sub>A</sub>	Operating Temperature	-40 to 85	°C	HY62UF16404E-I
T <sub>STG</sub>	Storage Temperature	-55 to 150	°C	
P <sub>D</sub>	Power Dissipation	1.0	W	
T <sub>SDER</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
Vcc	Supply Voltage	2.7	3.0	3.3	V
Vss	Ground	0	0	0	V
VIH	Input High Voltage	2.2	-	Vcc+0.3	V
VIL	Input Low Voltage	-0.3 <sup>1</sup>	-	0.6	V

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

**DC ELECTRICAL CHARACTERISTICS**

TA = -40°C to 85°C

Sym	Parameter	Test Condition	Min	Typ <sup>1</sup>	Max	Unit
ILI	Input Leakage Current	Vss ≤ VIN ≤ Vcc	-1	-	1	uA
ILO	Output Leakage Current	Vss ≤ VOUT ≤ Vcc, /CS = VIH or /OE = VIH or /WE = VIL or /UB = VIH, /LB = VIH	-1	-	1	uA
Icc	Operating Power Supply Current	/CS = VIL, VIN = VIH or VIL, I/O = 0mA			3	mA
ICC1	Average Operating Current	/CS = VIL, VIN = VIH or VIL, Cycle Time = Min, 100% Duty, I/O = 0mA	55ns		20	mA
			70ns		15	mA
		/CS ≤ 0.2V, VIN ≤ 0.2V or VIN ≥ Vcc-0.2V, Cycle Time = 1us, 100% Duty, I/O = 0mA			2	mA
ISB	Standby Current (TTL Input)	/CS = VIH or /UB, /LB = VIH VIN = VIH or VIL			300	uA
ISB1	Standby Current (CMOS Input)	/CS ≥ Vcc - 0.2V or /UB, /LB ≥ Vcc - 0.2V VIN ≥ Vcc - 0.2V or VIN ≤ Vss + 0.2V	SL	0.2	6	uA
			LL	0.2	10	uA
VOL	Output Low	IOL = 2.1mA	-	-	0.4	V
VOH	Output High	IOH = -1.0mA	2.4	-	-	V

Note

1. Typical values are at Vcc = 3.0V TA = 25°C
2. Typical values are not 100% tested

**CAPACITANCE**

(Temp = 25°C, f= 1.0MHz)

Symbol	Parameter	Condition	Max.	Unit
CIN	Input Capacitance(Add, /CS,/LB,/UB, /WE, /OE)	VIN = 0V	8	pF
COU	Output Capacitance(I/O)	VI/O = 0V	10	pF

Note : These parameters are sampled and not 100% tested

### AC CHARACTERISTICS

TA = -40°C to 85°C, unless otherwise specified

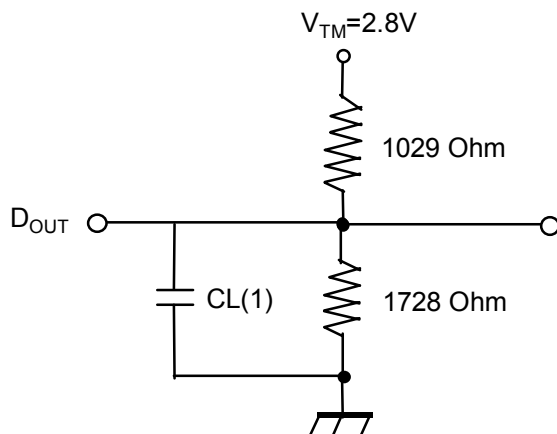
#	Symbol	Parameter	55ns		70ns		Unit
			Min.	Max.	Min.	Max.	
READ CYCLE							
1	tRC	Read Cycle Time	55	-	70	-	ns
2	tAA	Address Access Time	-	55	-	70	ns
3	tACS	Chip Select Access Time	-	55	-	70	ns
4	tOE	Output Enable to Output Valid	-	30	-	35	ns
5	tBA	/LB, /UB Access Time	-	55	-	70	ns
6	tCLZ	Chip Select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

### AC TEST CONDITIONS

TA = -40°C to 85°C, 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 = 30pF + 1TTL Load
	CL = 30pF + 1TTL Load

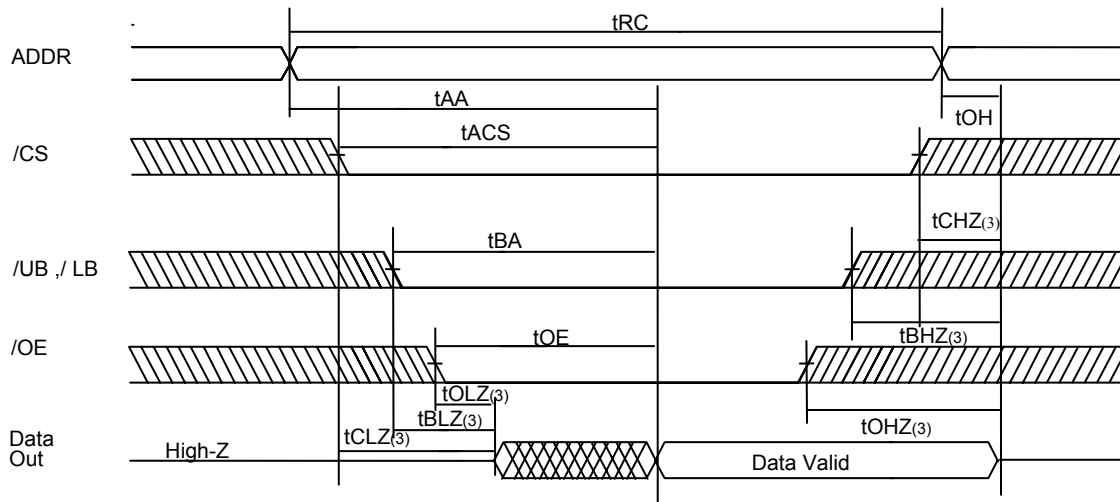
### AC TEST LOADS



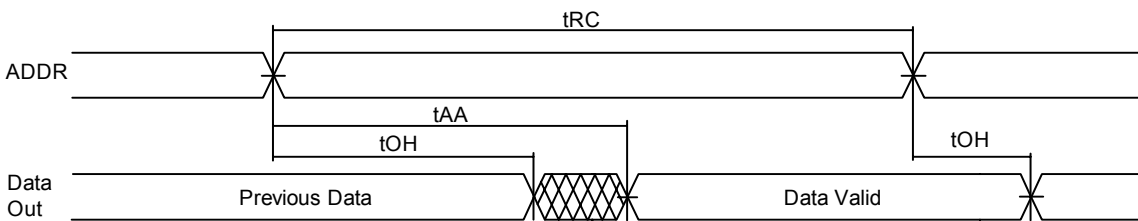
Note 1. Including jig and scope capacitance:

**TIMING DIAGRAM**

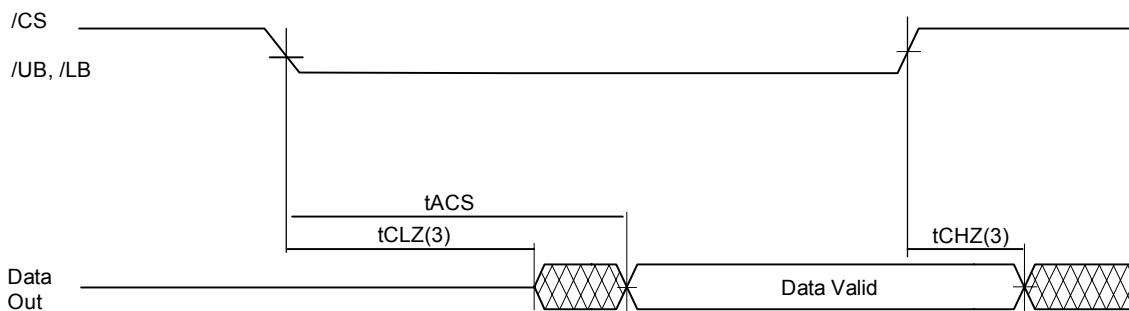
READ CYCLE 1 (Note 1,4)



READ CYCLE 2 (Note 1,2,4)



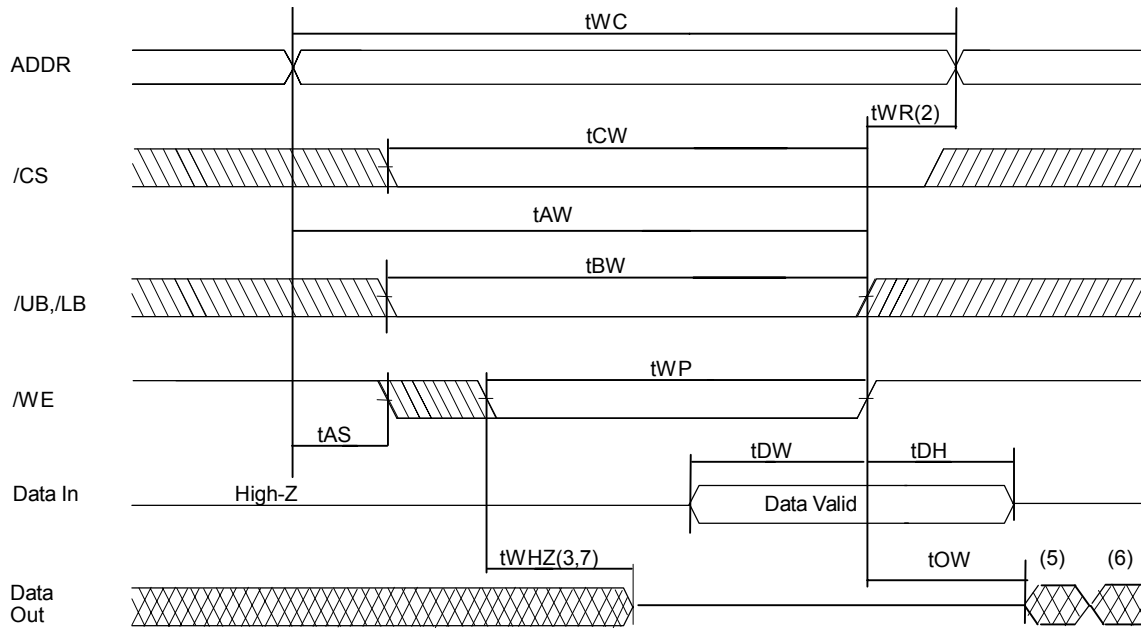
READ CYCLE 3 (Note 1,2,4)



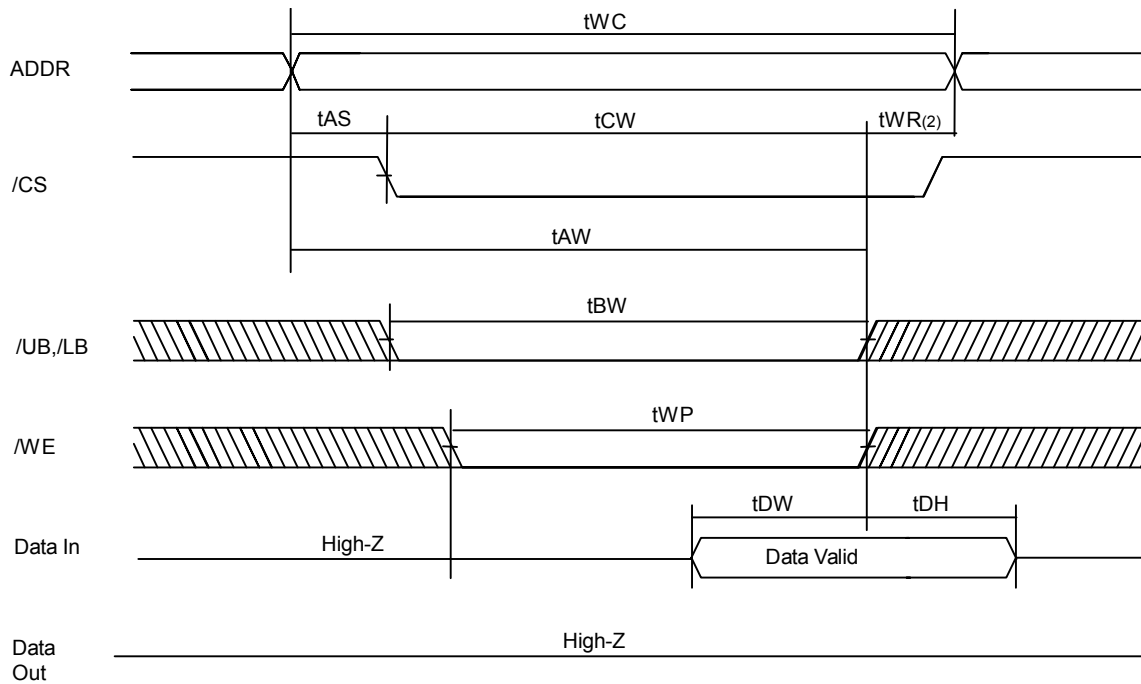
Notes:

1. A read occurs during the overlap of a low /OE, a high /WE, a low /CS and /UB and/or /LB .
2. /OE = VIL
3. tCHZ and tOHZ are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
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. /CS in high for the standby, low for active  
/UB and /LB in high for the standby, low for active

**DATA RETENTION ELECTRIC CHARACTERISTIC**

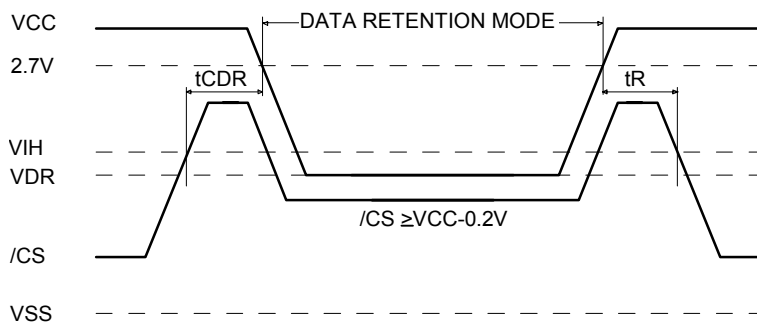
TA = -40°C to 85°C

Symbol	Parameter	Test Condition	Min	Typ <sup>1</sup>	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	SL	-	0.1	3	uA
			LL	-	0.1	6	uA
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 TA = 25°C.
2. Typical value are sampled and not 100% tested

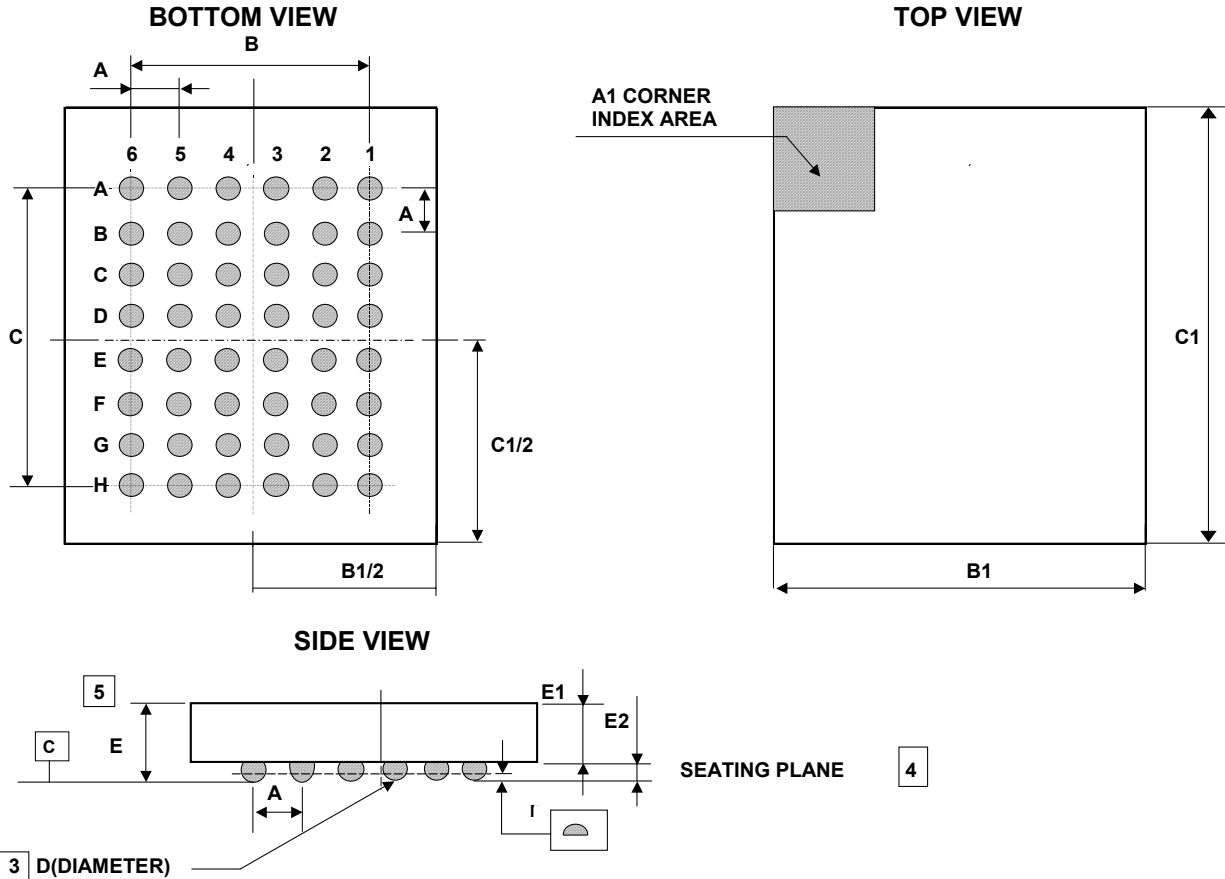
**DATA RETENTION TIMING DIAGRAM**





**PACKAGE INFORMATION (6.0mm X 7.0mm)**

48ball Fine Pitch Ball Grid Array Package (F)



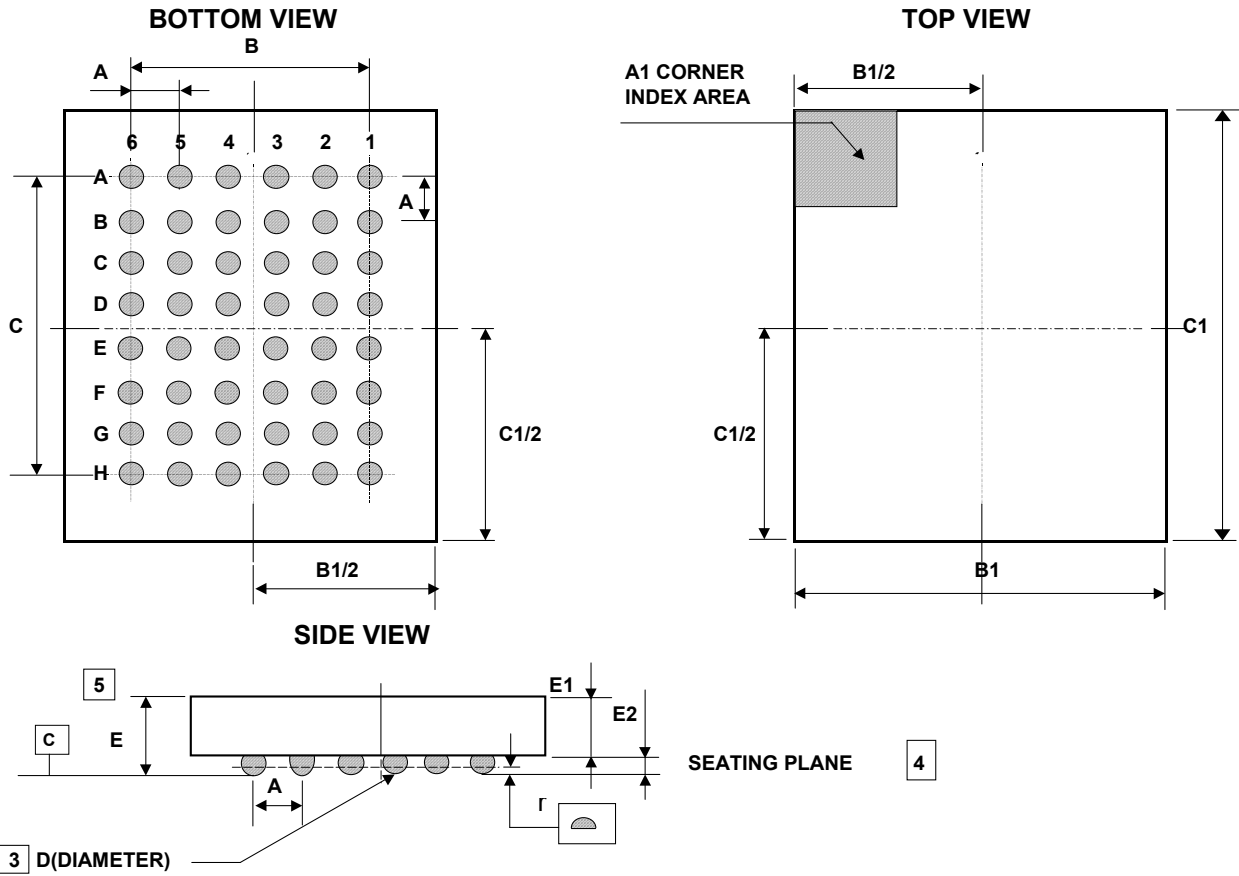
Symbol	Min.	Typ.	Max.
A	-	0.75	-
B	-	3.75	-
B1	5.9	6.0	6.1
C	-	5.25	-
C1	6.9	7.0	7.1
D	0.40	0.45	0.50
E	0.8	0.9	1.0
E1	-	0.55	-
E2	0.30	0.35	0.40
r	-	-	0.08

**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.

**PACKAGE INFORMATION (6.0mm X 8.0mm)**

48ball Fine Pitch Ball Grid Array Package(F)



Symbol	Min.	Typ.	Max.
A	-	0.75	-
B	-	3.75	-
B1	5.90	6.00	6.10
C	-	5.25	-
C1	7.90	8.00	8.10
D	0.3	0.35	0.4
E	0.9	1.0	1.10
E1	0.75	0.80	0.85
E2	0.17	-	-
r	-	-	0.12

**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
<p style="text-align: center;">FBGA</p>	

Index

• <b>HYUF6404E</b>	: Part Name
• <b>c</b>	: Power Consumption - D : Low Low Power - S : Super Low Power
• <b>ss</b>	: Speed - 50 : 55ns - 70 : 70ns
• <b>t</b>	: Temperature - I : Industrial ( -40 ~ 85 °C )
• <b>y</b>	: Year ( ex : 2 = year 2002, 3= year 2003 )
• <b>ww</b>	: Work Week ( ex : 12 = work week 12 )
• <b>p</b>	: Process Code - A (6.0mm X 7.0mm) - B (6.0mm X 8.0mm)
• <b>xxxxx</b>	: Lot No.
• <b>KOR</b>	: Origin Country
<b>Note</b>	
- Capital Letter	: Fixed Item
- Small Letter	: Non-fixed Item