Document Title

256K x16 bit 2.3 ~ 2.7V Super Low Power FCMOS Slow SRAM

Revision History

Revision No	History	Draft Date	Remark
00	Initial Draft	Dec.20.2000	Final
01	Changed Logo	Mar.23.2001	Final
02	Changed Isb1 values Changed part No Q -> L	Jun.07.2001	Final

DESCRIPTION

The HY62LF16406C is a high speed, super low power and 4Mbit full CMOS SRAM organized as 256K words by 16bits. The HY62LF16406C 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.

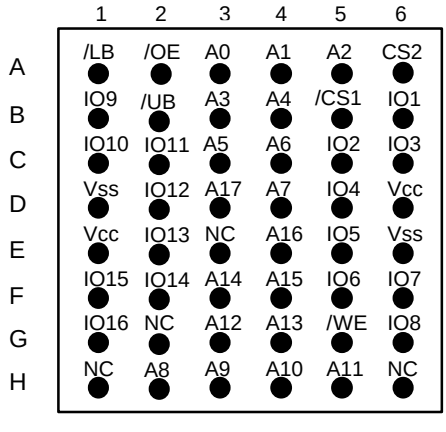
FEATURES

- 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/Icc(mA)	Standby Current(uA)		Temperature (°C)
				LL	SL	
HY62LF16406C-I	2.3~2.7	70/85	3	12	5	-40~85

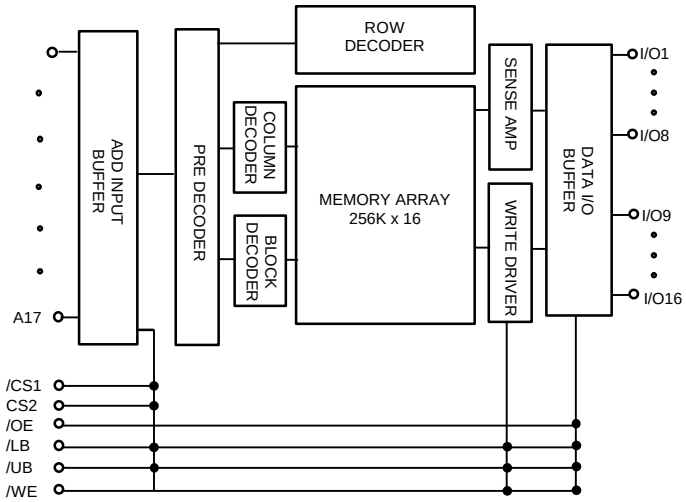
Note 1. Blank : Commercial, I : Industrial
2. Current value is max.

PIN CONNECTION



FBGA

BLOCK DIAGRAM



PIN DESCRIPTION

Pin Name	Pin Function	Pin Name	Pin Function
/CS1, CS2	Chip Select	I/O1~I/O16	Data Inputs/Outputs
/WE	Write Enable	A0~A17	Address Inputs
/OE	Output Enable	Vcc	Power (2.3~2.7V)
/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
HY62LF16404C-DM(I)	70/85	LL-part	I	uBGA
HY62LF16404C-SM(I)	70/85	SL-part	I	uBGA

Note 1. Blank : Commercial, I : Industrial

ABSOLUTE MAXIMUM RATINGS (1)

Symbol	Parameter	Rating	Unit	Remark
V_{IN}, V_{OUT}	Input/Output Voltage	-0.3 to 3.0	V	
Vcc	Power Supply	-0.3 to 4.0	V	
T_A	Operating Temperature	-40 to 85	°C	HY62LF16406C-I
T_{STG}	Storage Temperature	-55 to 150	°C	
P_D	Power Dissipation	1.0	W	
T_{SOLDER}	Ball Soldering Temperature & Time	260 • 10	°C•sec	

Note
1. 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

/CS1	CS2	/WE	/OE	/LB	/UB	Mode	I/O Pin		Power
							I/O1~I/O8	I/O9~I/O16	
H	X	X	X	X	X	Deselected	Hi-Z	Hi-Z	Standby
X	L	X	X	X	X				
X	X	X	X	H	H				
L	H	H	H	L	X	Output Disabled	Hi-Z	Hi-Z	Active
				X	L				
L	H	H	L	L	H	Read	D_{OUT}	Hi-Z	Active
				H	L		Hi-Z	D_{OUT}	
				L	L		D_{OUT}	D_{OUT}	
L	H	L	X	L	H	Write	D_{IN}	Hi-Z	Active
				H	L		Hi-Z	D_{IN}	
				L	L		D_{IN}	D_{IN}	

Note:
1. H=V_{IH}, L=V_{IL}, X=don't care (V_{IL} or V_{IH})
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
Vcc	Supply Voltage	2.3	2.5	2.7	V
Vss	Ground	0	0	0	V
V_{IH}	Input High Voltage	2.0	-	Vcc+0.3	V
V_{IL}	Input Low Voltage	-0.3[1.]	-	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

T_A = -40°C to 85°C

Sym	Parameter	Test Condition		Min	Typ[1.]	Max	Unit
I_{LI}	Input Leakage Current	Vss ≤ V_{IN} ≤ Vcc		-1	-	1	uA
I_{LO}	Output Leakage Current	Vss ≤ V_{OUT} ≤ Vcc, /CS1 = V_{IH} or CS2=V_{IL} or /OE = V_{IH} or /WE = V_{IL} or /UB = V_{IH} , /LB = V_{IH}		-1	-	1	uA
Icc	Operating Power Supply Current	/CS1 = V_{IL}, CS2=V_{IH}, V_{IN} = V_{IH} or V_{IL}, $I_{I/O}$ = 0mA				3	mA
I_{CC1}	Average Operating Current	/CS1 = V_{IL}, CS2 = V_{IH}, V_{IN} = V_{IH} or V_{IL}, Cycle Time = Min, 100% Duty, $I_{I/O}$ = 0mA				30	mA
		/CS1 ≤ 0.2V, CS2 ≥ Vcc-0.2V, V_{IN} ≤ 0.2V or V_{IN} ≥ Vcc-0.2V, Cycle Time = 1us, 100% Duty, $I_{I/O}$ = 0mA				3	mA
I_{SB}	Standby Current (TTL Input)	/CS1 = V_{IH} or CS2 = V_{IL} or /UB, /LB = V_{IH} V_{IN} = V_{IH} or V_{IL}				0.3	mA
I_{SB1}	Standby Current (CMOS Input)	/CS1 ≥ Vcc - 0.2V or CS2 ≤ Vss + 0.2V or /UB, /LB ≥ Vcc - 0.2V V_{IN} ≥ Vcc - 0.2V or V_{IN} ≤ Vss + 0.2V	SL		0.2	5	uA
			LL		0.2	12	uA
V_{OL}	Output Low	I_{OL} = 0.5mA		-	-	0.4	V
V_{OH}	Output High	I_{OH} = -0.5mA		2.0	-	-	V

Note
1. Typical values are at Vcc = 2.5V T_A = 25°C
2. Typical values are not 100% tested

CAPACITANCE

(Temp = 25°C, f= 1.0MHz)

Symbol	Parameter	Condition	Max.	Unit
C_{IN}	Input Capacitance (Add, /CS1,CS2,/LB,/UB, /WE, /OE)	V_{IN} = 0V	8	pF
C_{OUT}	Output Capacitance (I/O)	$V_{I/O}$ = 0V	10	pF

Note : These parameters are sampled and not 100% tested

AC CHARACTERISTICS

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

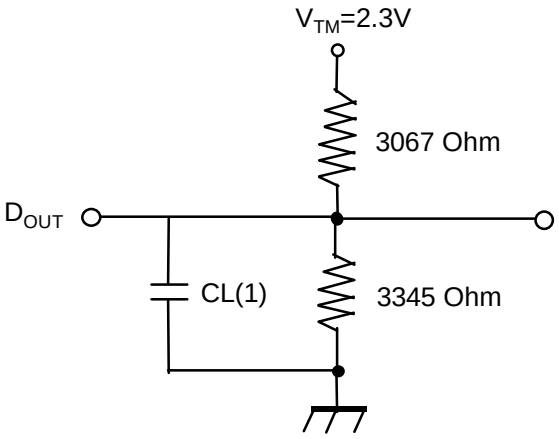
#	Symbol	Parameter	70ns		85ns		Unit
			Min.	Max.	Min.	Max.	
	READ CYCLE						
1	tRC	Read Cycle Time	70	-	85	-	ns
2	tAA	Address Access Time	-	70	-	85	ns
3	tACS	Chip Select Access Time	-	70	-	85	ns
4	tOE	Output Enable to Output Valid	-	35	-	40	ns
5	tBA	/LB, /UB Access Time	-	70	-	85	ns
6	tCLZ	Chip Select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

T_A = -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	CL = 5pF + 1TTL Load
	Others	CL = 30pF + 1TTL Load

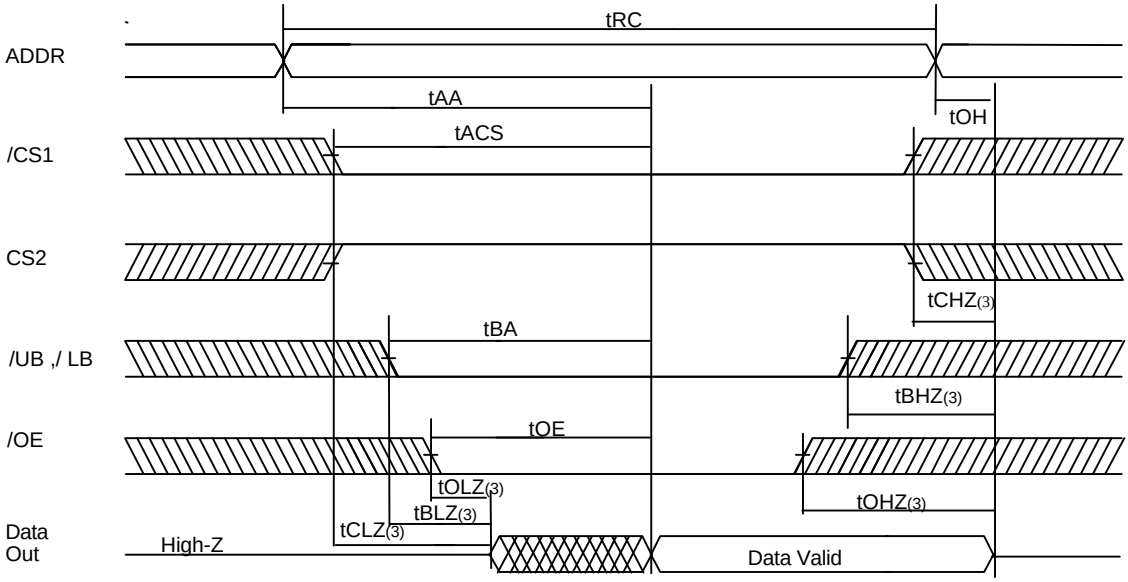
AC TEST LOADS



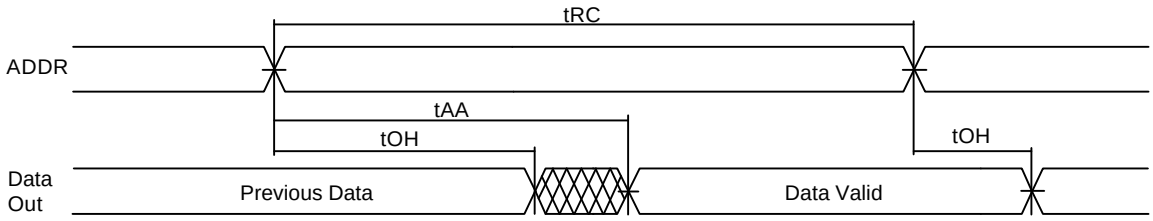
Note 1. Including jig and scope capacitance:

TIMING DIAGRAM

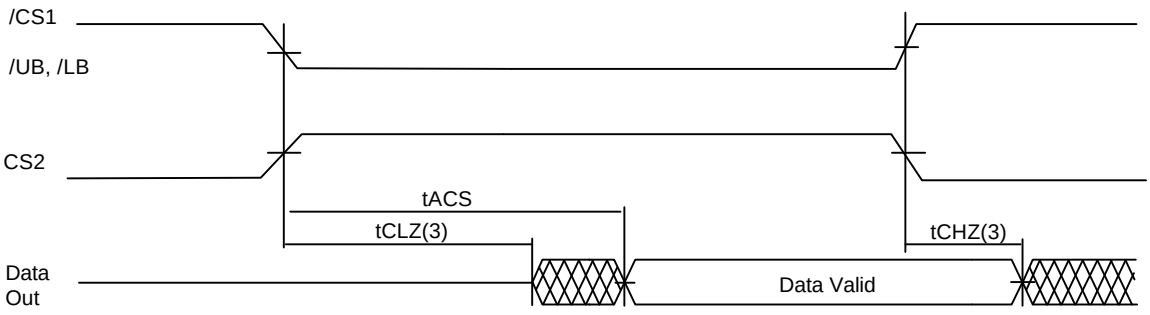
READ CYCLE 1(Note 1,4)



READ CYCLE 2(Note 1,2,4)

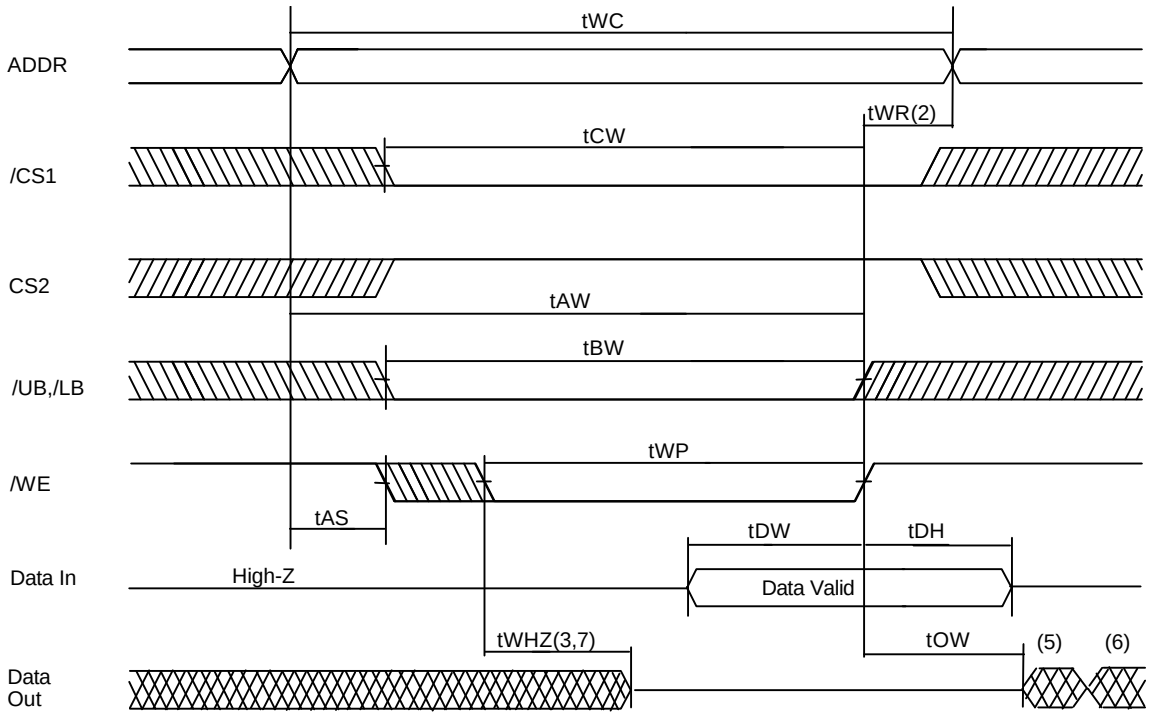


READ CYCLE 3(Note 1,2,4)

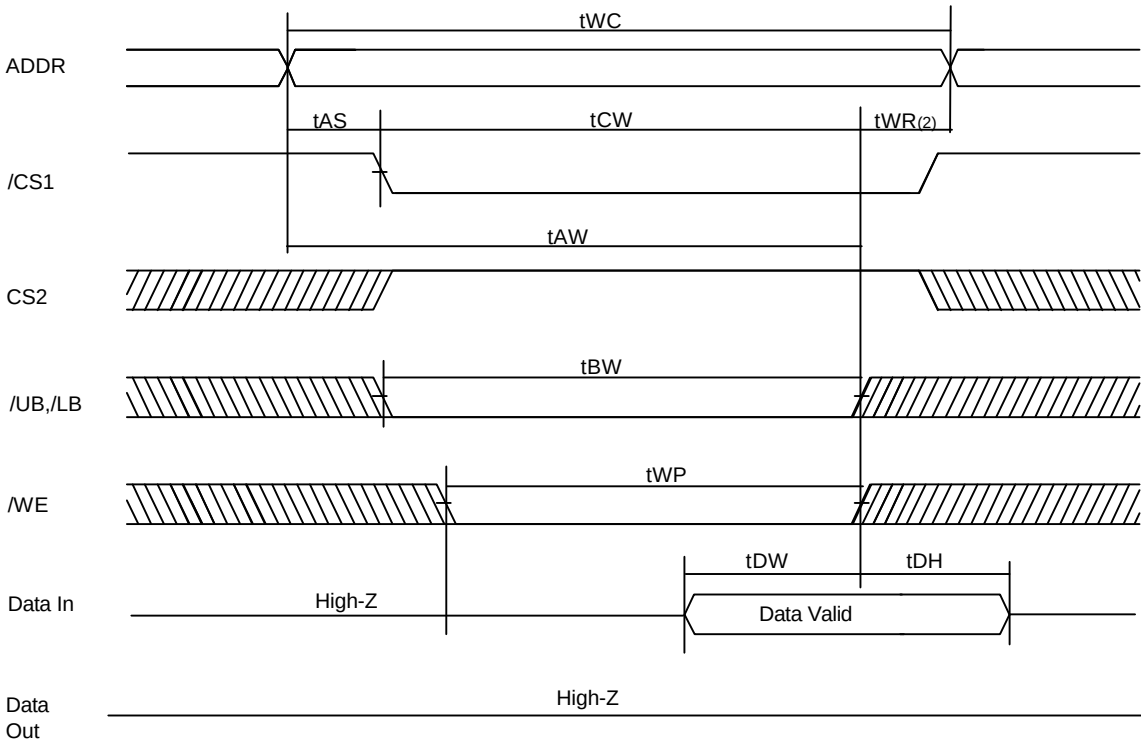


Notes:
1. Read Cycle occurs whenever a high on the /WE and /OE is low, while /UB and/or /LB and /CS1 and CS2 are in active status.
2. /OE = V_{IL}
3. Transition is measured ± 200mV from steady state voltage.
   This parameter is sampled and not 100% tested.
4. /CS1 in high for the standby, low for active
   CS2 in low for the standby, high 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) (/CS1, CS2 Controlled)



Notes:
1. A write occurs during the overlap of a low /WE, a low /CS1, a high CS2 and a low /UB and/or /LB .
2. tWR is measured from the earlier of /CS1, /LB, /UB, or /WE going high or CS2 going low 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 /CS1, /LB and /UB low transition and CS2 high 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. /CS1 in high for the standby, low for active
   CS2 in low for the standby, high for active.
   /UB and /LB in high for the standby, low for active

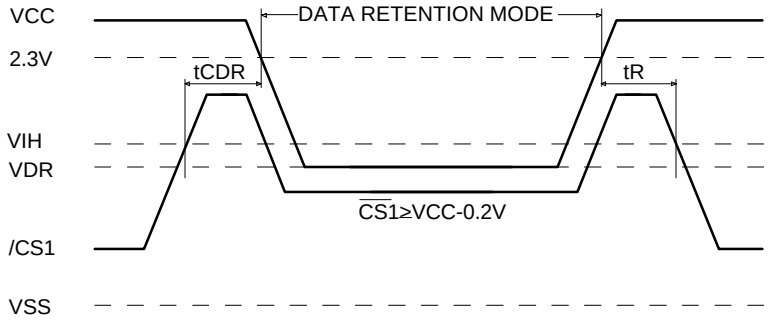
DATA RETENTION ELECTRIC CHARACTERISTIC

T_A= -40°C to 85°C

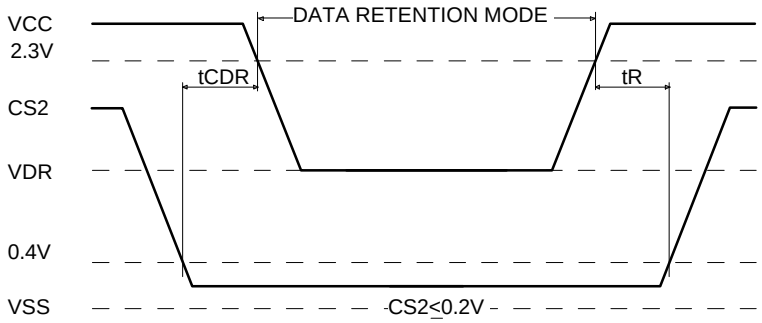
Symbol	Parameter	Test Condition		Min	Typ[1.]	Max	Unit
V_{DR}	Vcc for Data Retention	/CS1 ≥ Vcc - 0.2V or CS2 ≤ Vss + 0.2V or /UB, /LB ≥ Vcc - 0.2V, V_{IN} ≥ Vcc - 0.2V or V_{IN} ≤ Vss + 0.2V		1.2	-	2.7	V
Iccdr	Data Retention Current	Vcc=1.5V, /CS1 ≥ Vcc - 0.2V or CS2 ≤ Vss + 0.2V or /UB, /LB ≥ Vcc - 0.2V V_{IN} ≥ Vcc - 0.2V or V_{IN} ≤ Vss + 0.2V	SL	-	0.1	3	uA
			LL	-	0.1	10	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 T_A = 25°C.
2. Typical Value are sampled and not 100% tested

DATA RETENTION TIMING DIAGRAM 1

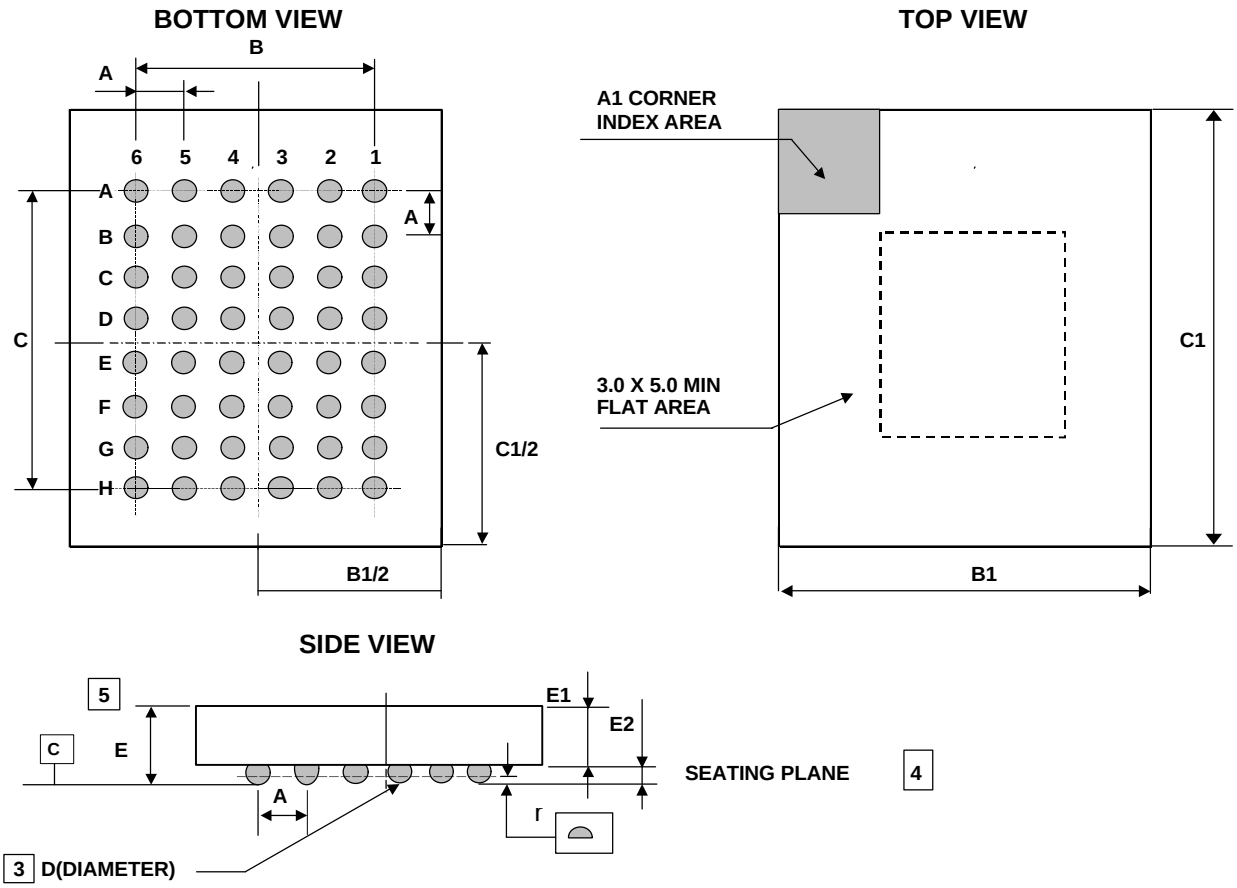


DATA RETENTION TIMING DIAGRAM 2



PACKAGE INFORMATION

48ball Micro Ball Grid Array Package(M)

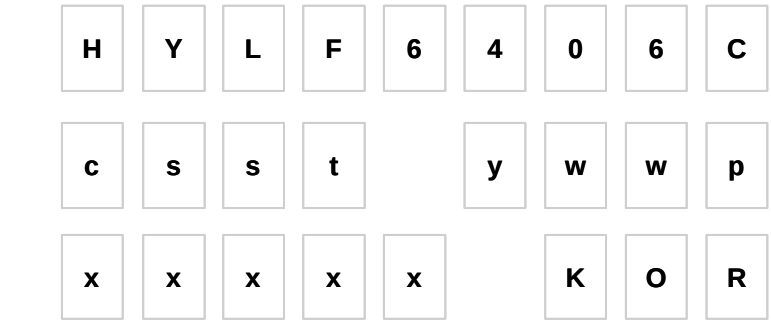


Symbol	Min.	Typ.	Max.
A	-	0.75	-
B	-	3.75	-
B1	6.7	6.8	6.9
C	-	5.25	-
C1	8.3	8.4	8.5
D	0.3	0.35	0.4
E	0.85	0.9	0.95
E1	0.6	0.65	0.7
E2	0.2	0.25	0.3
R	-	-	0.08

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	

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- **HYQF6406C** : Part Name
- **c** : Power Consumption
  - D : Low Low Power
  - S : Super Low Power
- **ss** : Speed
  - 70 : 70ns
  - 85 : 85ns
- **t** : Temperature
  - I : Industrial (-40 ~ 85 °C)
- **y** : Year (ex : 0 = year 2000, 1= year 2001)
- **ww** : Work Week (ex : 12 = work week 12)
- **p** : Process Code
- **xxxxx** : Lot No.
- **KOR** : Origin Country

Note

- Capital Letter : Fixed Item
- Small Letter : Non-fixed Item