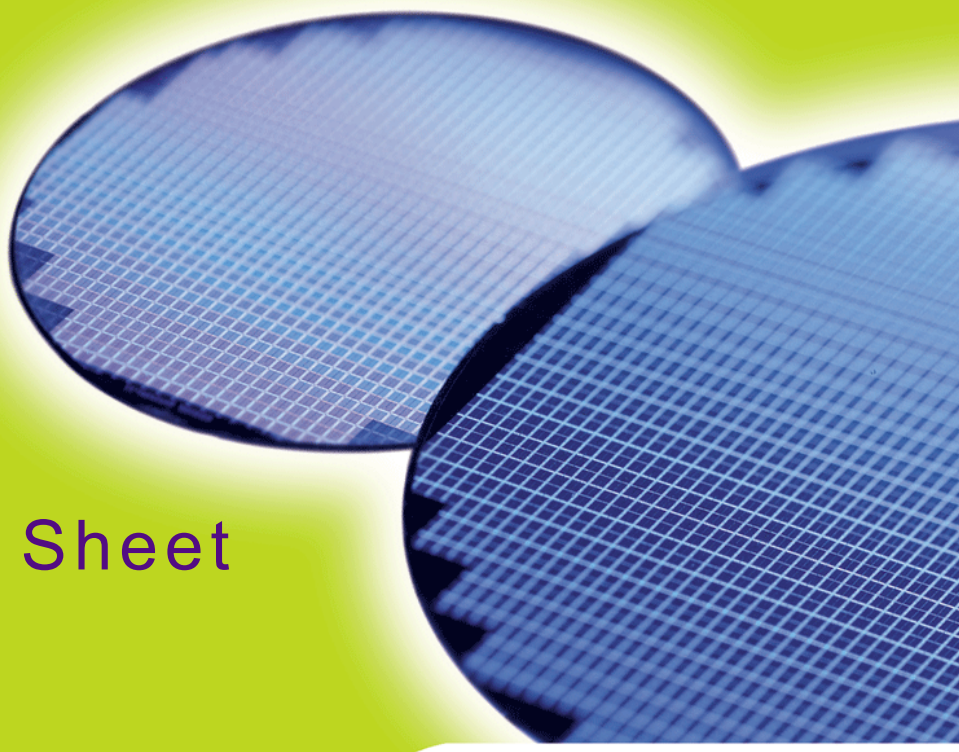
September 2006

HYS64D32020[H/G]DL–5–C
HYS64D[32/16]0x0[H/G]DL–6–C

200-Pin Small Outline Dual-In-Line Memory Modules
SO-DIMM
DDR SDRAM



Internet Data Sheet

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HYS64D32020[H/G]DL–5–C, HYS64D[32/16]0x0[H/G]DL–6–C Revision History: 2006-09, Rev. 1.31	
Page	**Subjects (major changes since last revision)**
All	Qimonda update
All	Adapted internet edition
Previous Revision: 2006-01, Rev. 1.3	
24	Changed t_{RFC} (for DDR400) from 70 ns to 65 ns as programmed in byte 42 SPD Code
Previous Revision: 2005-03, Rev. 1.2	

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1 Overview

This chapter lists all main features of the product family HYS64D[32/16]0x0[G/H]DL–[5/6]–C and the ordering information.

1.1 Features

- Non-parity 200-Pin Small Outline Dual-In-Line Memory Modules
- One rank 16M ×64 and two ranks 32M ×64 organization
- Standard Double Data Rate Synchronous DRAMs (DDR SDRAM)
- Single +2.5 V (± 0.2 V) power supply
- Built with 256-Mbit DDR SDRAMs organised as ×16 in P–TSOPII–66–1 packages
- Programmable CAS Latency, Burst Length, and Wrap Sequence (Sequential & Interleave)
- Auto Refresh (CBR) and Self Refresh
- RAS-lockout supported t_{RAP}=t_{RCD}
- All inputs and outputs SSTL_2 compatible
- Serial Presence Detect with E2PROM
- Standard form factor: 67.60 mm × 31.75 mm × 3.80 mm
- Standard reference layout Raw Cards A and C
- Gold contacts

TABLE 1
Performance

Part Number Speed Code			–5	–6	Unit
Speed Grade	Component		DDR400B	DDR333B	—
Max. Clock Frequency	@CL3	f_{CK3}	200	166	MHz
	@CL2.5	$f_{CK2.5}$	166	166	MHz
	@CL2	f_{CK2}	133	133	MHz

1.2 Description

The HYS64D32020[H/G]DL–5–C and HYS64D[32/16]0x0[H/G]DL–6–C are industry standard 200-Pin Small Outline Dual-In-Line Memory Modules (SO-DIMMs) organized as 32M × 64. The memory array is designed with Double Data Rate Synchronous DRAMs (DDR SDRAM). A variety of decoupling capacitors are mounted on the PC board. The DIMMs feature serial presence detect based on a serial E2PROM device using the 2-Pin I2C protocol. The first 128 bytes are programmed with configuration data and the second 128 bytes are available to the customer.

TABLE 2
Ordering Information for Lead Containing Products

Product Type	Compliance Code	Description	SDRAM Technology
PC3200 (CL=3.0)			
HYS64D32020GDL–5–C	PC3200S–3033–1–A1	two ranks 256 MB SO-DIMM	256 Mbit (×16)
PC2700 (CL=2.5)			
HYS64D16000GDL–6–C	PC2700S–2533–0–C1	one rank 128 MB SO-DIMM	256 Mbit (×16)
HYS64D32020GDL–6–C	PC2700S–2533–0–A1	two ranks 256 MB SO-DIMM	256 Mbit (×16)

green Product

TABLE 3
Ordering Information for RoHS Compliant Products

Product Type[1)]	Compliance Code	Description	SDRAM Technology
PC3200 (CL=3.0)			
HYS64D32020HDL–5–C	PC3200S–3033–1–A1	two ranks 256 MB SO-DIMM	256 Mbit (×16)
PC2700 (CL=2.5)			
HYS64D16000HDL–6–C	PC2700S–2533–0–C1	one rank 128 MB SO-DIMM	256 Mbit (×16)
HYS64D32020HDL–6–C	PC2700S–2533–0–A1	two ranks 256 MB SO-DIMM	256 Mbit (×16)

1) RoHS Compliant Product: Restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment as defined in the directive 2002/95/EC issued by the European Parliament and of the Council of 27 January 2003. These substances include mercury, lead, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated biphenyl ethers.

Notes

1. *Allproduct types end with a place code designating the silicon-die revision. Reference information available on request. Example: HYS64D32020GDL-6-C, indicating rev. C dies are used for SDRAM components.*
2. *The Compliance Code is printed on the module labels describing the speed sort (for example "PC2700"), the latencies and SPD code definition (for example "2033–0" means CAS latency of 2.0 clocks, RCD[1)] latency of 3 clocks, Row Precharge latency of 3 clocks, and JEDEC SPD code definiton version 0), and the Raw Card used for this module.*

1) RCD: Row-Column-Delay

2 Pin Configuration

The pin configuration of the Unbuffered Small Outline DDR SDRAM DIMM is listed by function in **Table 4** (200 pins). The abbreviations used in columns Pin and Buffer Type are explained in **Table 5** and **Table 6** respectively. The pin numbering is depicted in **Figure 1**.

TABLE 4
Pin Configuration of SO-DIMM

Pin#	Name	Pin Type	Buffer Type	Function
Clock Signals				
35	CK0	I	SSTL	**Clock Signal**
160	CK1	I	SSTL	**Clock Signal**
89	CK2	I	SSTL	**Clock Signal**
	NC	NC	–	
37	$\overline{CK0}$	I	SSTL	**Complement Clock**
158	$\overline{CK1}$	I	SSTL	**Complement Clock**
91	$\overline{CK2}$	I	SSTL	**Complement Clock**
	NC	NC	–	
96	CKE0	I	SSTL	**Clock Enable Rank 0**
95	CKE1	I	SSTL	**Clock Enable Rank 1** *Note: 2-rank module*
	NC	NC	–	*Note: 1-rank module*
Control Signals				
121	$\overline{S0}$	I	SSTL	**Chip Select Rank 0**
122	$\overline{S1}$	I	SSTL	**Chip Select Rank 1** *Note: 2-ranks module*
	NC	NC	–	*Note: 1-rank module*
118	$\overline{RAS}$	I	SSTL	**Row Address Strobe**
120	$\overline{CAS}$	I	SSTL	**Column Address Strobe**
119	$\overline{WE}$	I	SSTL	**Write Enable**

Pin#	Name	Pin Type	Buffer Type	Function
Address Signals				
117	BA0	I	SSTL	**Bank Address Bus 1:0**
116	BA1	I	SSTL	
112	A0	I	SSTL	**Address Bus 11:0**
111	A1	I	SSTL	
110	A2	I	SSTL	
109	A3	I	SSTL	
108	A4	I	SSTL	
107	A5	I	SSTL	
106	A6	I	SSTL	
105	A7	I	SSTL	
102	A8	I	SSTL	
101	A9	I	SSTL	
115	A10	I	SSTL	
	AP	I	SSTL	
100	A11	I	SSTL	
99	A12	I	SSTL	**Address Signal 12** *Note: Module base on 256 Mbit or larger dies*
	NC	NC	–	*Note: 128 Mbit based module*
123	A13	I	SSTL	**Address Signal 13** *Note: 1 Gbit based module*
	NC	NC	–	*Note: Module base on 512 Mbit or larger dies*
Data Signals				
5	DQ0	I/O	SSTL	**Data Bus 63:0**
7	DQ1	I/O	SSTL	
13	DQ2	I/O	SSTL	
17	DQ3	I/O	SSTL	
6	DQ4	I/O	SSTL	
8	DQ5	I/O	SSTL	
14	DQ6	I/O	SSTL	
18	DQ7	I/O	SSTL	
19	DQ8	I/O	SSTL	
23	DQ9	I/O	SSTL	
29	DQ10	I/O	SSTL	
31	DQ11	I/O	SSTL	
20	DQ12	I/O	SSTL	
24	DQ13	I/O	SSTL	

Pin#	Name	Pin Type	Buffer Type	Function
30	DQ14	I/O	SSTL	**Data Bus 63:0**
32	DQ15	I/O	SSTL	
41	DQ16	I/O	SSTL	
43	DQ17	I/O	SSTL	
49	DQ18	I/O	SSTL	
53	DQ19	I/O	SSTL	
42	DQ20	I/O	SSTL	
44	DQ21	I/O	SSTL	
50	DQ22	I/O	SSTL	
54	DQ23	I/O	SSTL	
55	DQ24	I/O	SSTL	
59	DQ25	I/O	SSTL	
65	DQ26	I/O	SSTL	
67	DQ27	I/O	SSTL	
56	DQ28	I/O	SSTL	
60	DQ29	I/O	SSTL	
66	DQ30	I/O	SSTL	
68	DQ31	I/O	SSTL	
127	DQ32	I/O	SSTL	
129	DQ33	I/O	SSTL	
135	DQ34	I/O	SSTL	
139	DQ35	I/O	SSTL	
128	DQ36	I/O	SSTL	
130	DQ37	I/O	SSTL	
136	DQ38	I/O	SSTL	
140	DQ39	I/O	SSTL	
141	DQ40	I/O	SSTL	
145	DQ41	I/O	SSTL	
151	DQ42	I/O	SSTL	
153	DQ43	I/O	SSTL	
142	DQ44	I/O	SSTL	
146	DQ45	I/O	SSTL	
152	DQ46	I/O	SSTL	
154	DQ47	I/O	SSTL	
163	DQ48	I/O	SSTL	
165	DQ49	I/O	SSTL	
171	DQ50	I/O	SSTL	
175	DQ51	I/O	SSTL	
164	DQ52	I/O	SSTL	
166	DQ53	I/O	SSTL	

Pin#	Name	Pin Type	Buffer Type	Function
172	DQ54	I/O	SSTL	**Data Bus 63:0**
176	DQ55	I/O	SSTL	
177	DQ56	I/O	SSTL	
181	DQ57	I/O	SSTL	
187	DQ58	I/O	SSTL	
189	DQ59	I/O	SSTL	
178	DQ60	I/O	SSTL	
182	DQ61	I/O	SSTL	
188	DQ62	I/O	SSTL	
190	DQ63	I/O	SSTL	
71	CB0	I/O	SSTL	**Check Bit 0**
	NC	NC	–	
73	CB1	I/O	SSTL	**Check Bit 1**
	NC	NC	–	
79	CB2	I/O	SSTL	**Check Bit 2**
	NC	NC	–	
83	CB3	I/O	SSTL	**Check Bit 3**
	NC	NC	–	
72	CB4	I/O	SSTL	**Check Bit 4**
	NC	NC	–	
74	CB5	I/O	SSTL	**Check Bit 5**
	NC	NC	–	
80	CB6	I/O	SSTL	**Check Bit 6**
	NC	NC	–	
84	CB7	I/O	SSTL	**Check Bit 7**
	NC	NC	–	
11	DQS0	I/O	SSTL	**Data Strobes 7:0**
25	DQS1	I/O	SSTL	
47	DQS2	I/O	SSTL	
61	DQS3	I/O	SSTL	
133	DQS4	I/O	SSTL	
147	DQS5	I/O	SSTL	
169	DQS6	I/O	SSTL	
183	DQS7	I/O	SSTL	
77	DQS8	I/O	SSTL	**Data Strobe 8**
	NC	NC	–	

Pin#	Name	Pin Type	Buffer Type	Function
12	DM0	I	SSTL	**Data Mask 7:0**
26	DM1	I	SSTL	
48	DM2	I	SSTL	
62	DM3	I	SSTL	
134	DM4	I	SSTL	
148	DM5	I	SSTL	
170	DM6	I	SSTL	
184	DM7	I	SSTL	
78	DM8	I	SSTL	**Data Mask 8**
	NC	NC	–	
EEPROM				
195	SCL	I	CMOS	**Serial Bus Clock**
193	SDA	I/O	OD	**Serial Bus Data**
194	SA0	I	CMOS	**Slave Address Select Bus 2:0**
196	SA1	I	CMOS	
198	SA2	I	CMOS	
Power Supplies				
1,2	V_{REF}	AI	–	**I/O Reference Voltage**
197	V_{DDSPD}	PWR	–	**EEPROM Power Supply**
9,10, 21, 22, 33, 34, 36, 22, 33, 34, 36, 45, 46, 57, 58, 69, 70, 81, 82, 92, 93, 94, 113, 114, 131, 132, 143, 144, 155, 156, 157, 167, 168, 179, 180, 191, 192	V_{DD}	PWR	–	**Power Supply**

Pin#	Name	Pin Type	Buffer Type	Function
3, 4, 15, 16, 27, 28, 38, 39, 40, 51, 52, 63, 64, 75, 76, 87, 88, 90, 103, 104, 125, 126, 137, 138,149, 150, 159, 161, 162, 173, 174,185, 186	V_{SS}	GND	–	**Ground Plane**
Other Pins				
199	V_{DDID}	O	OD	V_{DD} Identification
85, 86, 97, 98, 124, 200	NC	NC	–	**Not connected**

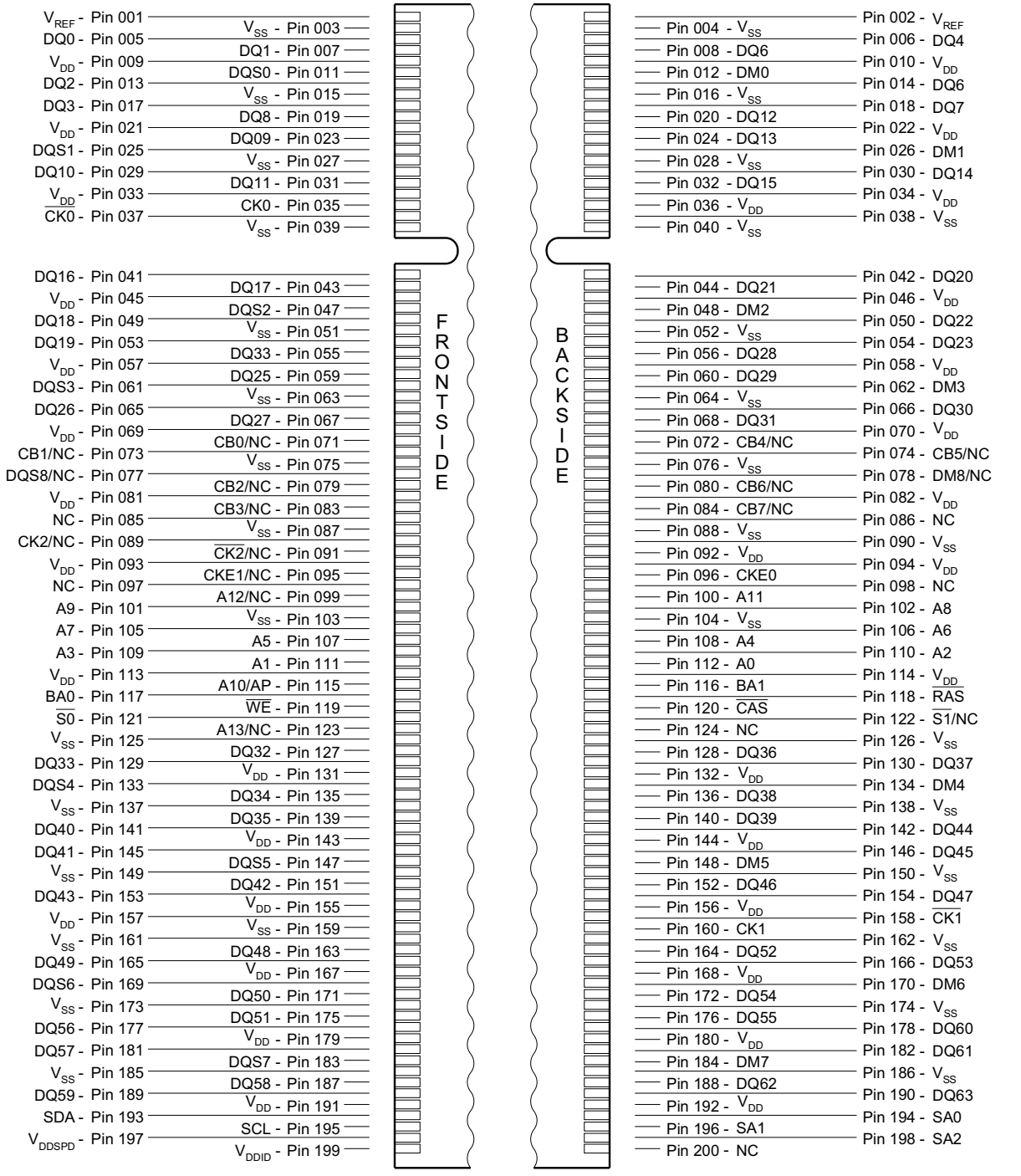
TABLE 5
Abbreviations for Pin Type

Abbreviation	Description
I	Standard input-only pin. Digital levels.
O	Output. Digital levels.
I/O	I/O is a bidirectional input/output signal.
AI	Input. Analog levels.
PWR	Power
GND	Ground
NC	Not Connected

TABLE 6
Abbreviations for Buffer Type

Abbreviation	Description
SSTL	Serial Stub Terminated Logic (SSTL2)
LV-CMOS	Low Voltage CMOS
CMOS	CMOS Levels
OD	Open Drain. The corresponding pin has 2 operational states, active low and tristate, and allows multiple devices to share as a wire-OR.

FIGURE 1
Pin Configuration Diagram 200-Pin SO-DIMM



3 Electrical Characteristics

3.1 Operating Conditions

TABLE 7
Absolute Maximum Ratings

Parameter	Symbol	Values			Unit	Note/ Test Condition
		min.	typ.	max.		
Voltage on I/O pins relative to V_{SS}	V_{IN}, V_{OUT}	–0.5	–	V_{DDQ} + 0.5	V	–
Voltage on inputs relative to V_{SS}	V_{IN}	–1	–	+3.6	V	–
Voltage on V_{DD} supply relative to V_{SS}	V_{DD}	–1	–	+3.6	V	–
Voltage on V_{DDQ} supply relative to V_{SS}	V_{DDQ}	–1	–	+3.6	V	–
Operating temperature (ambient)	T_A	0	–	+70	°C	–
Storage temperature (plastic)	T_{STG}	-55	–	+150	°C	–
Power dissipation (per SDRAM component)	PD	–	1	–	W	–
Short circuit output current	I_{OUT}	–	50	–	mA	–

Attention: Permanent damage to the device may occur if "Absolute Maximum Ratings" are exceeded. This is a stress rating only, and functional operation should be restricted to recommended operation conditions. Exposure to absolute maximum rating conditions for extended periods of time may affect device reliability and exceeding only one of the values may cause irreversible damage to the integrated circuit.

TABLE 8
Electrical Characteristics and DC Operating Conditions

Parameter	Symbol	Values			Unit	Note[1)]/Test Condition
		Min.	Typ.	Max.		
Device Supply Voltage	V_{DD}	2.3	2.5	2.7	V	$f_{CK} \leq$ 166 MHz
Device Supply Voltage	V_{DD}	2.5	2.6	2.7	V	f_{CK} > 166 MHz [2)]
Output Supply Voltage	V_{DDQ}	2.3	2.5	2.7	V	$f_{CK} \leq$ 166 MHz [3)]
Output Supply Voltage	V_{DDQ}	2.5	2.6	2.7	V	f_{CK} > 166 MHz [2)3)]
EEPROM supply voltage	V_{DDSPD}	2.3	2.5	3.6	V	—
Supply Voltage, I/O Supply Voltage	V_{SS}, V_{SSQ}	0	—	0	V	—
Input Reference Voltage	V_{REF}	0.49 × V_{DDQ}	0.5 × V_{DDQ}	0.51 × V_{DDQ}	V	[4)]
I/O Termination Voltage (System)	V_{TT}	V_{REF} – 0.04	—	V_{REF} + 0.04	V	[5)]

Parameter	Symbol	Values			Unit	Note[1)]/Test Condition
		Min.	Typ.	Max.		
Input High (Logic1) Voltage	$V_{IH(DC)}$	V_{REF} + 0.15	—	V_{DDQ} + 0.3	V	8)
Input Low (Logic0) Voltage	$V_{IL(DC)}$	–0.3	—	V_{REF} – 0.15	V	8)
Input Voltage Level, CK and $\overline{CK}$ Inputs	$V_{IN(DC)}$	–0.3	—	V_{DDQ} + 0.3	V	8)
Input Differential Voltage, CK and $\overline{CK}$ Inputs	$V_{ID(DC)}$	0.36	—	V_{DDQ} + 0.6	V	8)6)
VI-Matching Pull-up Current to Pull-down Current	VI_{Ratio}	0.71	—	1.4	—	7)
Input Leakage Current	I_I	–2	—	2	µA	Any input 0 V ≤ V_{IN} ≤ V_{DD}; All other pins not under test = 0 V 8)9)
Output Leakage Current	I_{OZ}	–5	—	5	µA	DQs are disabled; 0 V ≤ V_{OUT} ≤ V_{DDQ} 8)
Output High Current, Normal Strength Driver	I_{OH}	—	—	–16.2	mA	V_{OUT} = 1.95 V 8)
Output Low Current, Normal Strength Driver	I_{OL}	16.2	—	—	mA	V_{OUT} = 0.35 V8)

1) 0 °C ≤ T_A ≤ 70 °C
2) DDR400 conditions apply for all clock frequencies above 166 MHz
3) Under all conditions, V_{DDQ} must be less than or equal to V_{DD}.
4) Peak to peak AC noise on V_{REF} may not exceed ± 2% VREF (DC). VREF is also expected to track noise variations in V_{DDQ}.
5) V_{TT} is not applied directly to the device. V_{TT} is a system supply for signal termination resistors, is expected to be set equal to V_{REF}, and must track variations in the DC level of V_{REF}.
6) V_{ID} is the magnitude of the difference between the input level on CK and the input level on $\overline{CK}$.
7) The ration of the pull-up current to the pull-down current is specified for the same temperature and voltage, over the entire temperature and voltage range, for device drain to source voltage from 0.25 to 1.0 V. For a given output, it represents the maximum difference between pull-up and pull-down drivers due to process variation.
8) Inputs are not recognized as valid until V_{REF} stabilizes.
9) Values are shown per DDR SDRAM component

3.2 Current Specification and Conditions

TABLE 9
I_{DD} Conditions

Parameter	Symbol
Operating Current 0 one bank; active/ precharge; DQ, DM, and DQS inputs changing once per clock cycle; address and control inputs changing once every two clock cycles.	I_{DD0}
Operating Current 1 one bank; active/read/precharge; Burst Length = 4; see component data sheet.	I_{DD1}
Precharge Power-Down Standby Current all banks idle; power-down mode; CKE ≤ $V_{IL,MAX}$	I_{DD2P}
Precharge Floating Standby Current $\overline{CS}$ ≥ $V_{IH,,MIN}$, all banks idle; CKE ≥ $V_{IH,MIN}$; address and other control inputs changing once per clock cycle; V_{IN} = V_{REF} for DQ, DQS and DM.	I_{DD2F}
Precharge Quiet Standby Current $\overline{CS}$ ≥ V_{IHMIN}, all banks idle; CKE ≥ $V_{IH,MIN}$; V_{IN} = V_{REF} for DQ, DQS and DM; address and other control inputs stable at ≥ $V_{IH,MIN}$ or ≤ $V_{IL,MAX}$.	I_{DD2Q}
Active Power-Down Standby Current one bank active; power-down mode; CKE ≤ V_{ILMAX}; V_{IN} = V_{REF} for DQ, DQS and DM.	I_{DD3P}
Active Standby Current one bank active; $\overline{CS}$ ≥ $V_{IH,MIN}$; CKE ≥ $V_{IH,MIN}$; t_{RC} = $t_{RAS,MAX}$; DQ, DM and DQS inputs changing twice per clock cycle; address and control inputs changing once per clock cycle.	I_{DD3N}
Operating Current Read one bank active; Burst Length = 2; reads; continuous burst; address and control inputs changing once per clock cycle; 50% of data outputs changing on every clock edge; CL = 2 for DDR266(A), CL = 3 for DDR333 and DDR400B; I_{OUT} = 0 mA	I_{DD4R}
Operating Current Write one bank active; Burst Length = 2; writes; continuous burst; address and control inputs changing once per clock cycle; 50% of data outputs changing on every clock edge; CL = 2 for DDR266(A), CL = 3 for DDR333 and DDR400B	I_{DD4W}
Auto-Refresh Current t_{RC} = t_{RFCMIN}, burst refresh	I_{DD5}
Self-Refresh Current CKE ≤ 0.2 V; external clock on	I_{DD6}
Operating Current 7 four bank interleaving with Burst Length = 4; see component data sheet.	I_{DD7}

TABLE 10
I_{DD} Specification

Product Type	HYS64D32020HDL–5–C HYS64D32020GDL–5–C		HYS64D16000HDL–6–C HYS64D16000GDL–6–C		HYS64D32020HDL–6–C HYS64D32020GDL–6–C		Unit	Note [1)2)]
Organization	**256MB**		**128MB**		**256MB**			
	×64		**×64**		**×64**			
	2 Ranks		**1 Rank**		**2 Ranks**			
	–5		**–6**		**–6**			
Symbol	**Typ.**	**Max.**	**Typ.**	**Max.**	**Typ.**	**Max.**		
I_{DD0}	450	580	240	300	380	480	mA	3)
I_{DD1}	490	620	280	340	420	520	mA	3)4)
I_{DD2P}	30	40	20	20	30	40	mA	5)
I_{DD2F}	240	290	100	120	200	240	mA	5)
I_{DD2Q}	160	220	70	100	140	190	mA	5)
I_{DD3P}	100	140	40	60	90	120	mA	5)
I_{DD3N}	300	360	140	150	260	300	mA	5)
I_{DD4R}	510	620	280	340	420	520	mA	3)4)
I_{DD4W}	530	640	300	360	440	540	mA	3)
I_{DD5}	730	980	480	640	620	820	mA	3)
I_{DD6}	11.2	22.4	5.6	11.2	11.2	22.4	mA	5)
I_{DD7}	1010	1220	720	860	860	1040	mA	3)4)

1) Module I_{DD} values are calculated on the basis of component I_{DD} and can be measured differently depending on actual to DQ loading capacitance.
2) Test condition for maximum values: V_{DD} = 2.7 V, T_A = 10 °C
3) The module I_{DDx} values are calculated from the I_{DDx} values of the component data sheet as follows:
m × I_{DDx}[component] + **n** × I_{DD3N}[component] with **m** and **n** number of components of rank 1 and 2; **n**=0 for 1 rank modules
4) DQ I/O (I_{DDQ}) currents are not included in the calculations (see note 1))
5) The module I_{DDx} values are calculated from the corrponent I_{DDx} data sheet values as: (**m** + **n**) × I_{DDx}[component]

3.3 AC Characteristics

TABLE 11
AC Timing - Absolute Specifications for PC3200 and PC2700

Parameter	Symbol	–5		–6		Unit	Note[1)]/ Test Condition
		DDR400B		DDR333			
		Min.	Max.	Min.	Max.		
DQ output access time from CK/$\overline{CK}$	t_{AC}	–0.5	+0.5	–0.7	+0.7	ns	2)3)4)5)
CK high-level width	t_{CH}	0.45	0.55	0.45	0.55	t_{CK}	2)3)4)5)
Clock cycle time	t_{CK}	5	8	6	12	ns	CL = 3.0 2)3)4)5)
		6	12	6	12	ns	CL = 2.5 2)3)4)5)
		7.5	12	7.5	12	ns	CL = 2.0 2)3)4)5)
CK low-level width	t_{CL}	0.45	0.55	0.45	0.55	t_{CK}	2)3)4)5)
Auto precharge write recovery + precharge time	t_{DAL}	$(t_{WR}/t_{CK})+(t_{RP}/t_{CK})$				t_{CK}	2)3)4)5)6)
DQ and DM input hold time	t_{DH}	0.4	—	0.45	—	ns	2)3)4)5)
DQ and DM input pulse width (each input)	t_{DIPW}	1.75	—	1.75	—	ns	2)3)4)5)
DQS output access time from CK/$\overline{CK}$	t_{DQSCK}	–0.6	+0.6	–0.6	+0.6	ns	2)3)4)5)
DQS input low (high) pulse width (write cycle)	$t_{DQSL,H}$	0.35	—	0.35	—	t_{CK}	2)3)4)5)
DQS-DQ skew (DQS and associated DQ signals)	t_{DQSQ}	—	+0.40	—	+0.45	ns	TSOPII 2)3)4)5)
Write command to 1st DQS latching transition	t_{DQSS}	0.72	1.25	0.75	1.25	t_{CK}	2)3)4)5)
DQ and DM input setup time	t_{DS}	0.4	—	0.45	—	ns	2)3)4)5)
DQS falling edge hold time from CK (write cycle)	t_{DSH}	0.2	—	0.2	—	t_{CK}	2)3)4)5)
DQS falling edge to CK setup time (write cycle)	t_{DSS}	0.2	—	0.2	—	t_{CK}	2)3)4)5)
Clock Half Period	t_{HP}	Min. (t_{CL}, t_{CH})	—	Min. (t_{CL}, t_{CH})	—	ns	2)3)4)5)
Data-out high-impedance time from CK/$\overline{CK}$	t_{HZ}	—	+0.7	–0.7	+0.7	ns	2)3)4)5)7)
Address and control input hold time	t_{IH}	0.6	—	0.75	—	ns	Fast slew rate 3)4)5)6)8)
		0.7	—	0.8	—	ns	Slow slew rate 3)4)5)6)8)
Control and Addr. input pulse width (each input)	t_{IPW}	2.2	—	2.2	—	ns	2)3)4)5)9)

Parameter	Symbol	–5		–6		Unit	Note[1]/ Test Condition
		DDR400B		DDR333			
		Min.	Max.	Min.	Max.		
Address and control input setup time	t_{IS}	0.6	—	0.75	—	ns	Fast slew rate 3)4)5)6)8)
		0.7	—	0.8	—	ns	Slow slew rate 3)4)5)6)8)
Data-out low-impedance time from CK/$\overline{CK}$	t_{LZ}	–0.7	+0.7	–0.7	+0.7	ns	2)3)4)5)7)
Mode register set command cycle time	t_{MRD}	2	—	2	—	t_{CK}	2)3)4)5)
DQ/DQS output hold time	t_{QH}	$t_{HP} - t_{QH}$	—	$t_{HP} - t_{QHS}$	—	ns	2)3)4)5)
Data hold skew factor	t_{QHS}	—	+0.50	—	+0.55	ns	TSOPII 2)3)4)5)
Active to Autoprecharge delay	t_{RAP}	t_{RCD}	—	t_{RCD}	—	ns	2)3)4)5)
Active to Precharge command	t_{RAS}	40	70E+3	42	70E+3	ns	2)3)4)5)
Active to Active/Auto-refresh command period	t_{RC}	55	—	60	—	ns	2)3)4)5)
Active to Read or Write delay	t_{RCD}	15	—	18	—	ns	2)3)4)5)
Average Periodic Refresh Interval	t_{REFI}	—	7.8	—	7.8	µs	2)3)4)5)10)
Auto-refresh to Active/Auto-refresh command period	t_{RFC}	65	—	72	—	ns	2)3)4)5)
Precharge command period	t_{RP}	15	—	18	—	ns	2)3)4)5)
Read preamble	t_{RPRE}	0.9	1.1	0.9	1.1	t_{CK}	2)3)4)5)
Read postamble	t_{RPST}	0.40	0.60	0.40	0.60	t_{CK}	2)3)4)5)
Active bank A to Active bank B command	t_{RRD}	10	—	12	—	ns	2)3)4)5)
Write preamble	t_{WPRE}	0.25	—	0.25	—	t_{CK}	2)3)4)5)
Write preamble setup time	t_{WPRES}	0	—	0	—	ns	2)3)4)5)11)
Write postamble	t_{WPST}	0.40	0.60	0.40	0.60	t_{CK}	2)3)4)5)12)
Write recovery time	t_{WR}	15	—	15	—	ns	2)3)4)5)
Internal write to read command delay	t_{WTR}	2	—	1	—	t_{CK}	2)3)4)5)
Exit self-refresh to non-read command	t_{XSNR}	75	—	75	—	ns	2)3)4)5)
Exit self-refresh to read command	t_{XSRD}	200	—	200	—	t_{CK}	2)3)4)5)

1) 0 °C ≤ T_A ≤ 70 °C; V_{DDQ} = 2.5 V ± 0.2 V, V_{DD} = +2.5 V ± 0.2 V (DDR333); V_{DDQ} = 2.6 V ± 0.1 V, V_{DD} = +2.6 V ± 0.1 V (DDR400)
2) Input slew rate ≥Σ 1 V/ns for DDR400, DDR333
3) The CK/$\overline{CK}$ input reference level (for timing reference to CK/$\overline{CK}$) is the point at which CK and $\overline{CK}$ cross: the input reference level for signals other than CK/$\overline{CK}$, is V_{REF}. CK/$\overline{CK}$ slew rate are ≥ 1.0 V/ns.
4) Inputs are not recognized as valid until V_{REF} stabilizes.
5) The Output timing reference level, as measured at the timing reference point indicated in AC Characteristics (note 3) is V_{TT}.
6) For each of the terms, if not already an integer, round to the next highest integer. t_{CK} is equal to the actual system clock cycle time.
7) t_{HZ} and t_{LZ} transitions occur in the same access time windows as valid data transitions. These parameters are not referred to a specific voltage level, but specify when the device is no longer driving (HZ), or begins driving (LZ).
8) Fast slew rate ≥ 1.0 V/ns, slow slew rate ≥ 0.5 V/ns and < 1 V/ns for command/address and CK & CK slew rate > 1.0 V/ns, measured between V_{IH}(ac) and V_{IL}(ac).
9) These parameters guarantee device timing, but they are not necessarily tested on each device.

10) A maximum of eight Autorefresh commands can be posted to any given DDR SDRAM device.
11) The specific requirement is that DQS be valid (HIGH, LOW, or some point on a valid transition) on or before this CK edge. A valid transition is defined as monotonic and meeting the input slew rate specifications of the device. When no writes were previously in progress on the bus, DQS will be transitioning from Hi-Z to logic LOW. If a previous write was in progress, DQS could be HIGH, LOW, or transitioning from HIGH to LOW at this time, depending on t_{DQSS}.
12) The maximum limit for this parameter is not a device limit. The device operates with a greater value for this parameter, but system performance (bus turnaround) degrades accordingly.

4 SPD Codes

This chapter lists all hexadecimal byte values stored in the EEPROM of the products described in this data sheet. SPD stands for serial presence detect. All values with XX in the table are module specific bytes which are defined during production.

List of SPD Code Tables

TABLE 12
SPD Codes for HYSHYS64D32020[H/G]DL–5–C

Product Type		HYS64D32020HDL–5–C	HYS64D32020GDL–5–C
Organization		256MB	256MB
		×64	×64
		2 Ranks (×16)	2 Ranks (×16)
Label Code		PC3200S–30331	PC3200S–30331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX
0	Programmed SPD Bytes in E2PROM	80	80
1	Total number of Bytes in E2PROM	08	08
2	Memory Type (DDR = 07h)	07	07
3	Number of Row Addresses	0D	0D
4	Number of Column Addresses	09	09
5	Number of DIMM Ranks	02	02
6	Data Width (LSB)	40	40
7	Data Width (MSB)	00	00
8	Interface Voltage Levels	04	04
9	t_{CK} @ CL_{max} (Byte 18) [ns]	50	50
10	t_{AC} SDRAM @ CL_{max} (Byte 18) [ns]	50	50
11	Error Correction Support	00	00
12	Refresh Rate	82	82
13	Primary SDRAM Width	10	10
14	Error Checking SDRAM Width	00	00
15	t_{CCD} [cycles]	01	01
16	Burst Length Supported	0E	0E
17	Number of Banks on SDRAM Device	04	04
18	CAS Latency	1C	1C
19	CS Latency	01	01

Product Type		**HYS64D32020HDL–5–C**	**HYS64D32020GDL–5–C**
Organization		**256MB**	**256MB**
		×64	**×64**
		2 Ranks (×16)	**2 Ranks (×16)**
Label Code		**PC3200S–30331**	**PC3200S–30331**
JEDEC SPD Revision		**Rev. 1.0**	**Rev. 1.0**
Byte#	**Description**	**HEX**	**HEX**
20	Write Latency	02	02
21	DIMM Attributes	20	20
22	Component Attributes	C1	C1
23	t_{CK} @ CL_{max} -0.5 (Byte 18) [ns]	60	60
24	t_{AC} SDRAM @ CL_{max} -0.5 [ns]	50	50
25	t_{CK} @ CL_{max} -1 (Byte 18) [ns]	75	75
26	t_{AC} SDRAM @ CL_{max} -1 [ns]	50	50
27	t_{RPmin} [ns]	3C	3C
28	t_{RRDmin} [ns]	28	28
29	t_{RCDmin} [ns]	3C	3C
30	t_{RASmin} [ns]	28	28
31	Module Density per Rank	20	20
32	$t_{AS,}$ t_{CS} [ns]	60	60
33	$t_{AH,}$ t_{CH} [ns]	60	60
34	t_{DS} [ns]	40	40
35	t_{DH} [ns]	40	40
36 - 40	Not used	00	00
41	t_{RCmin} [ns]	37	37
42	t_{RFCmin} [ns]	41	41
43	t_{CKmax} [ns]	28	28
44	$t_{DQSQmax}$ [ns]	28	28
45	t_{QHSmax} [ns]	50	50
46	not used	00	00
47	DIMM PCB Height	01	01
48 - 61	Not used	00	00
62	SPD Revision	10	10
63	Checksum of Byte 0-62	F6	F6
64	Manufacturer’s JEDEC ID Code (1)	7F	7F
65	Manufacturer’s JEDEC ID Code (2)	7F	7F
66	Manufacturer’s JEDEC ID Code (3)	7F	7F
67	Manufacturer’s JEDEC ID Code (4)	7F	7F
68	Manufacturer’s JEDEC ID Code (5)	7F	7F
69	Manufacturer’s JEDEC ID Code (6)	51	51

Product Type		**HYS64D32020HDL–5–C**	**HYS64D32020GDL–5–C**
Organization		**256MB**	**256MB**
		×64	**×64**
		2 Ranks (×16)	**2 Ranks (×16)**
Label Code		**PC3200S–30331**	**PC3200S–30331**
JEDEC SPD Revision		**Rev. 1.0**	**Rev. 1.0**
Byte#	**Description**	**HEX**	**HEX**
70	Manufacturer's JEDEC ID Code (7)	00	00
71	Manufacturer's JEDEC ID Code (8)	00	00
72	Module Manufacturer Location	xx	xx
73	Part Number, Char 1	36	36
74	Part Number, Char 2	34	34
75	Part Number, Char 3	44	44
76	Part Number, Char 4	33	33
77	Part Number, Char 5	32	32
78	Part Number, Char 6	30	30
79	Part Number, Char 7	32	32
80	Part Number, Char 8	30	30
81	Part Number, Char 9	48	47
82	Part Number, Char 10	44	44
83	Part Number, Char 11	4C	4C
84	Part Number, Char 12	35	35
85	Part Number, Char 13	43	43
86	Part Number, Char 14	20	20
87	Part Number, Char 15	20	20
88	Part Number, Char 16	20	20
89	Part Number, Char 17	20	20
90	Part Number, Char 18	20	20
91	Module Revision Code	1x	1x
92	Test Program Revision Code	xx	xx
93	Module Manufacturing Date Year	xx	xx
94	Module Manufacturing Date Week	xx	xx
95 - 98	Module Serial Number	xx	xx
99 - 127	Not used	00	00

TABLE 13
SPD Codes for HYS64D16000[H/G]DL–6–C

Product Type		HYS64D16000HDL–6–C	HYS64D16000GDL–6–C
Organization		0.13 GByte	0.13 GByte
		×64	×64
		1 Rank (×16)	1 Rank (×16)
Label Code		PC2700S–25330	PC2700S–25330
JEDEC SPD Revision		Rev. 0.0	Rev. 0.0
Byte#	**Description**	**HEX**	**HEX**
0	Programmed SPD Bytes in E2PROM	80	80
1	Total number of Bytes in E2PROM	08	08
2	Memory Type (DDR = 07h)	07	07
3	Number of Row Addresses	0D	0D
4	Number of Column Addresses	09	09
5	Number of DIMM Ranks	01	01
6	Data Width (LSB)	40	40
7	Data Width (MSB)	00	00
8	Interface Voltage Levels	04	04
9	t_{CK} @ CL_{max} (Byte 18) [ns]	60	60
10	t_{AC} SDRAM @ CL_{max} (Byte 18) [ns]	70	70
11	Error Correction Support	00	00
12	Refresh Rate	82	82
13	Primary SDRAM Width	10	10
14	Error Checking SDRAM Width	00	00
15	t_{CCD} [cycles]	01	01
16	Burst Length Supported	0E	0E
17	Number of Banks on SDRAM Device	04	04
18	CAS Latency	0C	0C
19	CS Latency	01	01
20	Write Latency	02	02
21	DIMM Attributes	20	20
22	Component Attributes	C1	C1
23	t_{CK} @ CL_{max} -0.5 (Byte 18) [ns]	75	75
24	t_{AC} SDRAM @ CL_{max} -0.5 [ns]	70	70
25	t_{CK} @ CL_{max} -1 (Byte 18) [ns]	00	00
26	t_{AC} SDRAM @ CL_{max} -1 [ns]	00	00
27	t_{RPmin} [ns]	48	48
28	t_{RRDmin} [ns]	30	30
29	t_{RCDmin} [ns]	48	48

Product Type		**HYS64D16000HDL–6–C**	**HYS64D16000GDL–6–C**
Organization		**0.13 GByte**	**0.13 GByte**
		×64	**×64**
		1 Rank (×16)	**1 Rank (×16)**
Label Code		**PC2700S–25330**	**PC2700S–25330**
JEDEC SPD Revision		**Rev. 0.0**	**Rev. 0.0**
Byte#	**Description**	**HEX**	**HEX**
30	t_{RASmin} [ns]	2A	2A
31	Module Density per Rank	20	20
32	$t_{AS,}$ t_{CS} [ns]	75	75
33	$t_{AH,}$ t_{CH} [ns]	75	75
34	t_{DS} [ns]	45	45
35	t_{DH} [ns]	45	45
36 - 40	Not used	00	00
41	t_{RCmin} [ns]	3C	3C
42	t_{RFCmin} [ns]	48	48
43	t_{CKmax} [ns]	30	30
44	$t_{DQSQmax}$ [ns]	2D	2D
45	t_{QHSmax} [ns]	55	55
46	not used	00	00
47	DIMM PCB Height	00	00
48 - 61	Not used	00	00
62	SPD Revision	00	00
63	Checksum of Byte 0-62	E8	E8
64	Manufacturer’s JEDEC ID Code (1)	7F	7F
65	Manufacturer’s JEDEC ID Code (2)	7F	7F
66	Manufacturer’s JEDEC ID Code (3)	7F	7F
67	Manufacturer’s JEDEC ID Code (4)	7F	7F
68	Manufacturer’s JEDEC ID Code (5)	7F	7F
69	Manufacturer’s JEDEC ID Code (6)	51	51
70	Manufacturer’s JEDEC ID Code (7)	00	00
71	Manufacturer’s JEDEC ID Code (8)	00	00
72	Module Manufacturer Location	xx	xx
73	Part Number, Char 1	36	36
74	Part Number, Char 2	34	34
75	Part Number, Char 3	44	44
76	Part Number, Char 4	31	31
77	Part Number, Char 5	36	36
78	Part Number, Char 6	30	30
79	Part Number, Char 7	30	30

Product Type		**HYS64D16000HDL–6–C**	**HYS64D16000GDL–6–C**
Organization		**0.13 GByte**	**0.13 GByte**
		×64	**×64**
		1 Rank (×16)	**1 Rank (×16)**
Label Code		**PC2700S–25330**	**PC2700S–25330**
JEDEC SPD Revision		**Rev. 0.0**	**Rev. 0.0**
Byte#	**Description**	**HEX**	**HEX**
80	Part Number, Char 8	30	30
81	Part Number, Char 9	48	47
82	Part Number, Char 10	44	44
83	Part Number, Char 11	4C	4C
84	Part Number, Char 12	36	36
85	Part Number, Char 13	43	43
86	Part Number, Char 14	20	20
87	Part Number, Char 15	20	20
88	Part Number, Char 16	20	20
89	Part Number, Char 17	20	20
90	Part Number, Char 18	20	20
91	Module Revision Code	1x	1x
92	Test Program Revision Code	xx	xx
93	Module Manufacturing Date Year	xx	xx
94	Module Manufacturing Date Week	xx	xx
95 - 98	Module Serial Number	xx	xx
99 - 127	Not used	00	00

TABLE 14
SPD Codes for HYS64D32020[G/H]DL–6–C

Product Type		HYS64D32020HDL–6–C	HYS64D32020GDL–6–C
Organization		256MB	256MB
		×64	×64
		2 Ranks (×16)	2 Ranks (×16)
Label Code		PC2700S–25330	PC2700S–25330
JEDEC SPD Revision		Rev. 0.0	Rev. 0.0
Byte#	**Description**	**HEX**	**HEX**
0	Programmed SPD Bytes in E2PROM	80	80
1	Total number of Bytes in E2PROM	08	08
2	Memory Type (DDR = 07h)	07	07
3	Number of Row Addresses	0D	0D
4	Number of Column Addresses	09	09
5	Number of DIMM Ranks	02	02
6	Data Width (LSB)	40	40
7	Data Width (MSB)	00	00
8	Interface Voltage Levels	04	04
9	t_{CK} @ CL_{max} (Byte 18) [ns]	60	60
10	t_{AC} SDRAM @ CL_{max} (Byte 18) [ns]	70	70
11	Error Correction Support	00	00
12	Refresh Rate	82	82
13	Primary SDRAM Width	10	10
14	Error Checking SDRAM Width	00	00
15	t_{CCD} [cycles]	01	01
16	Burst Length Supported	0E	0E
17	Number of Banks on SDRAM Device	04	04
18	CAS Latency	0C	0C
19	CS Latency	01	01
20	Write Latency	02	02
21	DIMM Attributes	20	20
22	Component Attributes	C1	C1
23	t_{CK} @ CL_{max} -0.5 (Byte 18) [ns]	75	75
24	t_{AC} SDRAM @ CL_{max} -0.5 [ns]	70	70
25	t_{CK} @ CL_{max} -1 (Byte 18) [ns]	00	00
26	t_{AC} SDRAM @ CL_{max} -1 [ns]	00	00
27	t_{RPmin} [ns]	48	48
28	t_{RRDmin} [ns]	30	30
29	t_{RCDmin} [ns]	48	48

Product Type		**HYS64D32020HDL–6–C**	**HYS64D32020GDL–6–C**
Organization		**256MB**	**256MB**
		×64	**×64**
		2 Ranks (×16)	**2 Ranks (×16)**
Label Code		**PC2700S–25330**	**PC2700S–25330**
JEDEC SPD Revision		**Rev. 0.0**	**Rev. 0.0**
Byte#	**Description**	**HEX**	**HEX**
30	t_{RASmin} [ns]	2A	2A
31	Module Density per Rank	20	20
32	$t_{AS,}$ t_{CS} [ns]	75	75
33	$t_{AH,}$ t_{CH} [ns]	75	75
34	t_{DS} [ns]	45	45
35	t_{DH} [ns]	45	45
36 - 40	Not used	00	00
41	t_{RCmin} [ns]	3C	3C
42	t_{RFCmin} [ns]	48	48
43	t_{CKmax} [ns]	30	30
44	$t_{DQSQmax}$ [ns]	2D	2D
45	t_{QHSmax} [ns]	55	55
46	not used	00	00
47	DIMM PCB Height	00	00
48 - 61	Not used	00	00
62	SPD Revision	00	00
63	Checksum of Byte 0-62	E9	E9
64	Manufacturer’s JEDEC ID Code (1)	7F	7F
65	Manufacturer’s JEDEC ID Code (2)	7F	7F
66	Manufacturer’s JEDEC ID Code (3)	7F	7F
67	Manufacturer’s JEDEC ID Code (4)	7F	7F
68	Manufacturer’s JEDEC ID Code (5)	7F	7F
69	Manufacturer’s JEDEC ID Code (6)	51	51
70	Manufacturer’s JEDEC ID Code (7)	00	00
71	Manufacturer’s JEDEC ID Code (8)	00	00
72	Module Manufacturer Location	xx	xx
73	Part Number, Char 1	36	36
74	Part Number, Char 2	34	34
75	Part Number, Char 3	44	44
76	Part Number, Char 4	33	33
77	Part Number, Char 5	32	32
78	Part Number, Char 6	30	30
79	Part Number, Char 7	32	32

Product Type		HYS64D32020HDL–6–C	HYS64D32020GDL–6–C
Organization		256MB	256MB
		×64	×64
		2 Ranks (×16)	2 Ranks (×16)
Label Code		PC2700S–25330	PC2700S–25330
JEDEC SPD Revision		Rev. 0.0	Rev. 0.0
Byte#	**Description**	**HEX**	**HEX**
80	Part Number, Char 8	30	30
81	Part Number, Char 9	48	47
82	Part Number, Char 10	44	44
83	Part Number, Char 11	4C	4C
84	Part Number, Char 12	36	36
85	Part Number, Char 13	43	43
86	Part Number, Char 14	20	20
87	Part Number, Char 15	20	20
88	Part Number, Char 16	20	20
89	Part Number, Char 17	20	20
90	Part Number, Char 18	20	20
91	Module Revision Code	1x	1x
92	Test Program Revision Code	xx	xx
93	Module Manufacturing Date Year	xx	xx
94	Module Manufacturing Date Week	xx	xx
95 - 98	Module Serial Number	xx	xx
99 - 127	Not used	00	00

5 Package Outlines

FIGURE 2
Package Outline SO-DIMM Raw Card A (L-DIM-200-6)

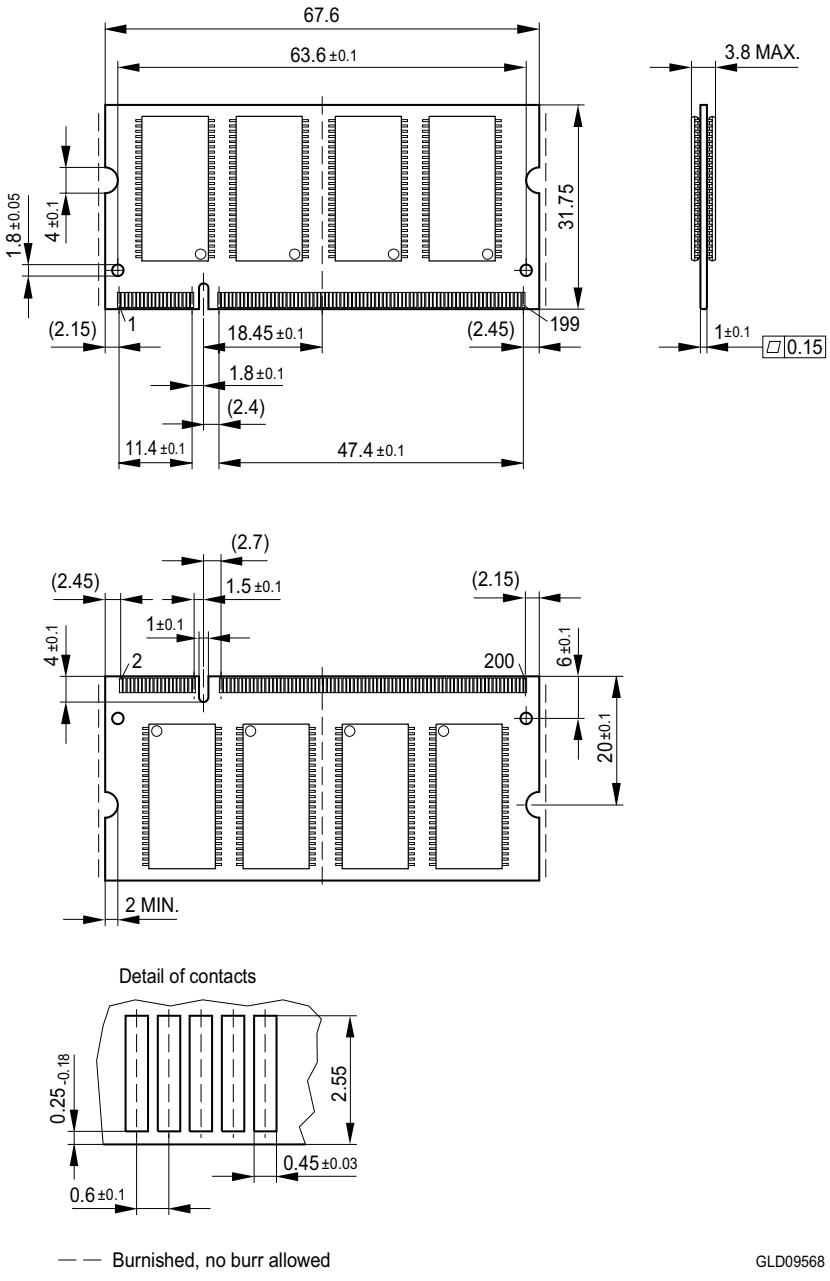
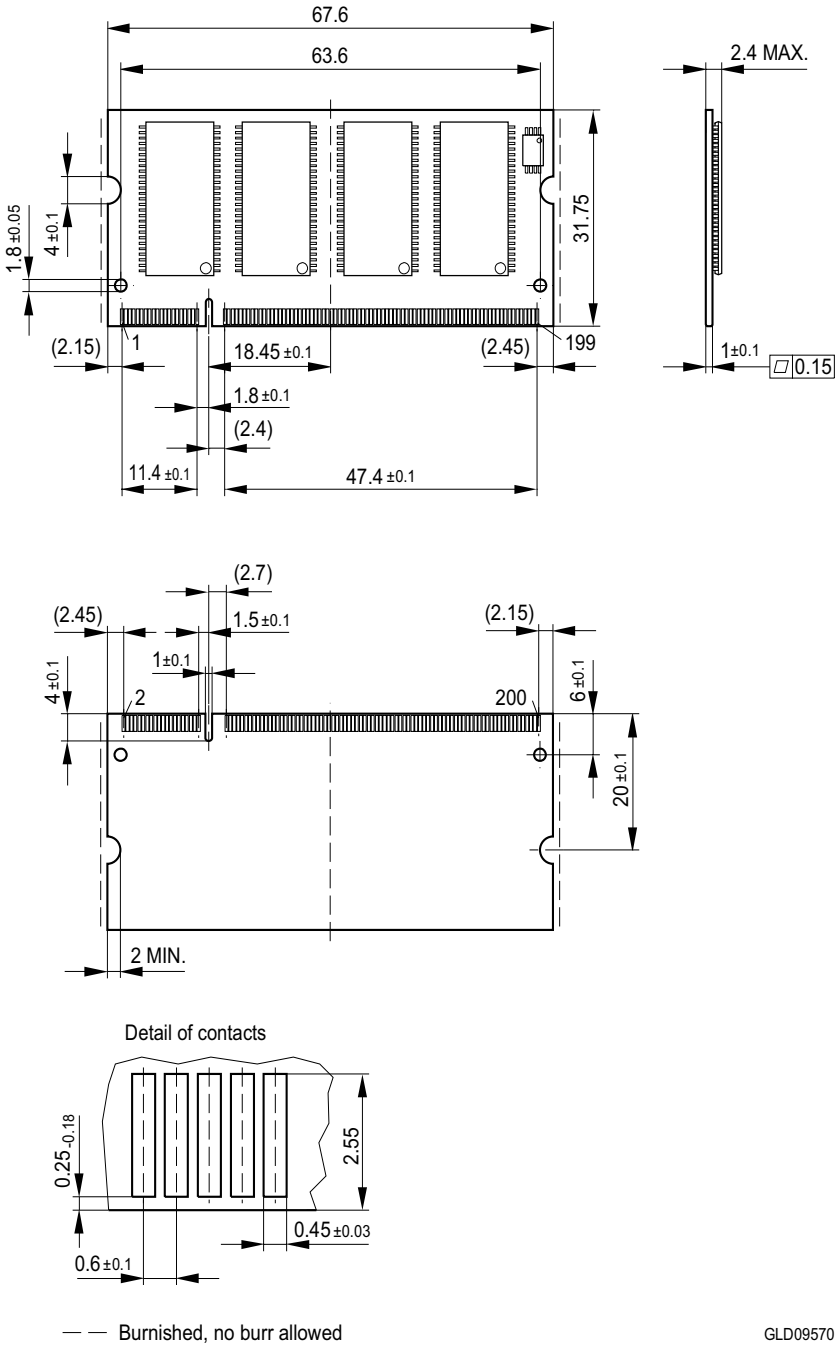


FIGURE 3
Package Outline SO-DIMM Raw Card C (L-DIM-200-11)



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