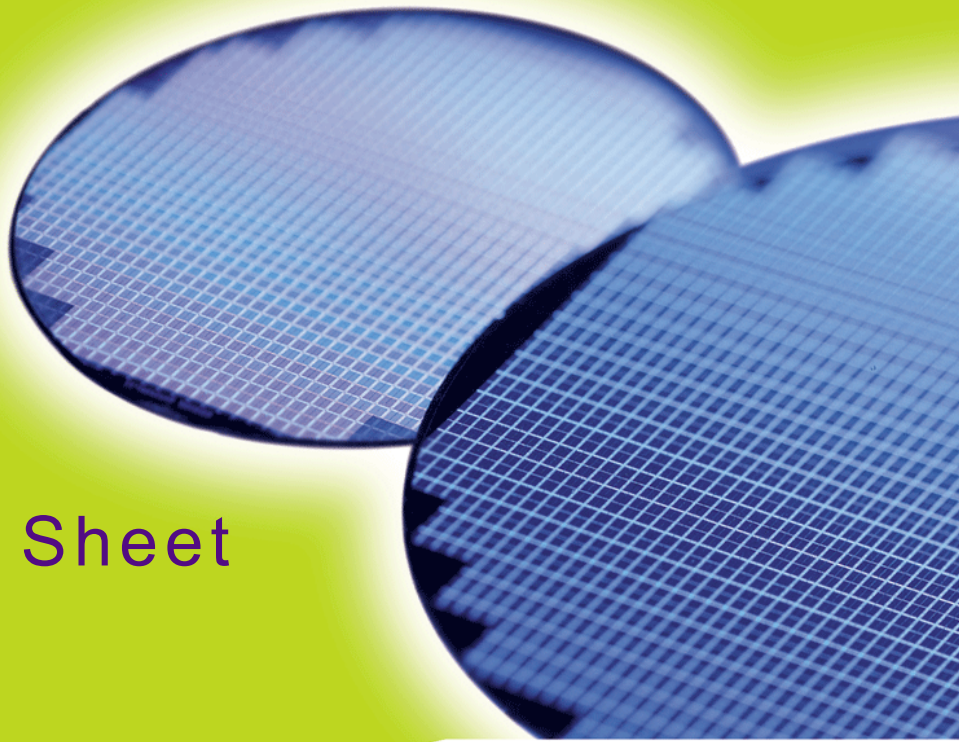


HYS72D32300[G/H]BR-[5/6/7]-C  
HYS72D64300[G/H]BR-[5/6/7]-C  
HYS72D64320[G/H]BR-[5/6]-C  
HYS72D128320[G/H]BR-[6/7]-C

*184-Pin Registered Double Data Rate SDRAM Module  
Reg DIMM  
DDR SDRAM*



## Internet Data Sheet

*Rev. 1.32*

HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

HYS72D32300[G/H]BR-[5/6/7]-C, HYS72D64300[G/H]BR-[5/6/7]-C, HYS72D64320[G/H]BR-[5/6]-C, HYS72D128320[G/H]BR-[6/7]-C	
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All	Adapted internet edition
6	Table updated
<b>Previous Revision: Rev. 1.31, 2006-09</b>	
All	Qimonda update
<b>Previous Revision: Rev. 1.3, 2005-11</b>	

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HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

# 1 Overview

This chapter gives an overview of the 184-pin Registered Double Data Rate DDR2 SDRAM Modules with parity bit product family and describes its main characteristics.

## 1.1 Features

- 184-Pin Registered 8-Byte Dual-In-Line DDR SDRAM Module for “1U” PC, Workstation and Server main memory applications
- One rank 32M × 72 and 64M × 72 and two ranks 64M × 72 and 128M × 72 organization
- JEDEC standard Double Data Rate Synchronous DRAMs (DDR SDRAM) with a single + 2.5 V (± 0.2 V) power supply and + 2.6 V (± 0.1 V) power supply for DDR400
- Built with 256-Mbit DDR SDRAMs in P--TFBGA-60-1 packages
- Programmable CAS Latency, Burst Length, and Wrap Sequence (Sequential & Interleave)
- Auto Refresh (CBR) and Self Refresh
- All inputs and outputs SSTL\_2 compatible
- Re-drive for all input signals using register and PLL devices.
- Serial Presence Detect with E<sup>2</sup>PROM
- Low Profile Modules form factor: 133.35 mm × 28.58 mm × 4.00 mm / 2.64 mm and for 1GB 133.35 mm × 30.48 mm (1.2") × 4.00 mm
- JEDEC standard reference layout for one rank 256 MB, 512 MB and two ranks 512 MB, 1 GB: PC 2700 and PC 3200 Registered DIMM Raw Cards A,B,C,D
- Gold plated contacts

**TABLE 1**  
Performance

Part Number Speed Code		-5	-6	-7	Unit	
Speed Grade	Component	DDR400B	DDR333B	DDR266A	—	
	Module	PC3200-3033	PC2700-2533	PC2100-2033	—	
max. Clock Frequency	@CL3	$f_{CK3}$	200	166	—	MHz
	@CL2.5	$f_{CK2.5}$	166	166	143	MHz
	@CL2	$f_{CK2}$	133	133	133	MHz

## 1.2 Description

The HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C and HYS72D64320GBR-5-C are low profile versions of the standard Registered DIMM modules suitable for 1U Server Applications. The Low Profile DIMM versions are available as 32M × 72 (256 MB), 64M × 72 (512 MB), 128M × 72 (1 GB) The memory array is designed with Double Data Rate Synchronous DRAMs for ECC applications. All control and address signals are re-driven on the DIMM using register

devices and a PLL for the clock distribution. This reduces capacitive loading to the system bus, but adds one cycle to the SDRAM timing. A variety of decoupling capacitors are mounted on the PC board. The DIMMs feature serial presence detect based on a serial E<sup>2</sup>PROM device using the 2-pin I<sup>2</sup>C protocol. The first 128 bytes are programmed with configuration data and the second 128 bytes are available to the customer.

HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM**TABLE 2**  
Ordering Information for Lead-Containing Products

Product Type	Compliance Code	Description	SDRAM Technology
<b>PC3200 (CL = 3.0)</b>			
HYS72D32300GBR-5-C	PC3200R-30330-A0	1 Rank 256 MB Registered DIMM ECC	256 Mbit (×8)
HYS72D64300GBR-5-C	PC3200R-30330-C0	1 Rank 512 MB Registered DIMM ECC	256 Mbit (×4)
HYS72D64320GBR-5-C	PC3200R-30330-B0	2 Ranks 512 MB Registered DIMM ECC	256 Mbit (×8)
<b>PC2700 (CL = 2.5)</b>			
HYS72D32300GBR-6-C	PC2700R-25330-A0	1 Rank 256 MB Registered DIMM ECC	256 Mbit (×8)
HYS72D64300GBR-6-C	PC2700R-25330-C0	1 Rank 512 MB Registered DIMM ECC	256 Mbit (×4)
HYS72D64320GBR-6-C	PC2700R-25330-B0	2 Ranks 512 MB Registered DIMM ECC	256 Mbit (×8)
HYS72D128320GBR-6-C	PC2700R-25330-D0	2 Ranks 1 GB Registered DIMM ECC	256 Mbit (×4)
<b>PC2100 (CL = 2.0)</b>			
HYS72D32300GBR-7-C	PC2100R-20330-A0	1 Rank 256 MB Registered DIMM ECC	256 Mbit (×8)
HYS72D64300GBR-7-C	PC2100R-20330-C0	1 Rank 512 MB Registered DIMM ECC	256 Mbit (×4)
HYS72D128320GBR-7-C	PC2100R-20330-D0	2 Ranks 1 GB Registered DIMM ECC	256 Mbit (×4)



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

**TABLE 3****Ordering Information for Lead-Free (RoHS Compliant) Products**

Product Type <sup>1)</sup>	Compliance Code <sup>2)</sup>	Description	SDRAM Technology	Note <sup>3)</sup>
<b>PC3200 (CL = 3.0)</b>				
HYS72D32300HBR-5-C	PC3200R-30330-A0	1 Rank 256 MB Registered DIMM ECC	256 Mbit (×8)	
HYS72D64300HBR-5-C	PC3200R-30330-C0	1 Rank 512 MB Registered DIMM ECC	256 Mbit (×4)	
HYS72D64320HBR-5-C	PC3200R-30330-B0	2 Ranks 512 MB Registered DIMM ECC	256 Mbit (×8)	
<b>PC2700 (CL = 2.5)</b>				
HYS72D32300HBR-6-C	PC2700R-25330-A0	1 Rank 256 MB Registered DIMM ECC	256 Mbit (×8)	
HYS72D64300HBR-6-C	PC2700R-25330-C0	1 Rank 512 MB Registered DIMM ECC	256 Mbit (×4)	
HYS72D64320HBR-6-C	PC2700R-25330-B0	2 Ranks 512 MB Registered DIMM ECC	256 Mbit (×8)	
HYS72D128320HBR-6-C	PC2700R-25330-D0	2 Ranks 1 GB Registered DIMM ECC	256 Mbit (×4)	
<b>PC2100 (CL = 2.0)</b>				
HYS72D32300HBR-7-C	PC2100R-20330-A0	1 Rank 256 MB Registered DIMM ECC	256 Mbit (×8)	
HYS72D64300HBR-7-C	PC2100R-20330-C0	1 Rank 512 MB Registered DIMM ECC	256 Mbit (×4)	
HYS72D128320HBR-7-C	PC2100R-20330-D0	2 Ranks 1 GB Registered DIMM ECC	256 Mbit (×4)	

- 1) All product types end with a place code designating the silicon-die revision. Reference information available on request.  
Example: HYS72D128300GBR-5-B, indicating Rev.B die are used for SDRAM components.
- 2) The Compliance Code is printed on the module labels and describes the speed sort (for example "PC2100R"), the latencies (for example "20330" means CAS latency of 2.0 clocks, Row-Column-Delay (RCD) latency of 3 clocks and Row Precharge latency of 3 clocks), JEDEC SPD code definition version 0, and the Raw Card used for this module.
- 3) 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.



## 2 Pin Configuration

The pin configuration of the Registered DDR SDRAM DIMM is listed by function in **Table 4** (184 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 RDIMM

Pin #	Name	Pin Type	Buffer Type	Function
<b>Clock Signals</b>				
137	CK0	I	SSTL	<b>Clock Signal</b>
138	$\overline{\text{CK0}}$	I	SSTL	<b>Complement Clock</b>
21	CKE0	I	SSTL	<b>Clock Enable Rank 0</b>
111	CKE1	I	SSTL	<b>Clock Enable Rank 1</b> <i>Note: 2-rank module</i>
	NC	NC	SSTL	<i>Note: 1-rank module</i>
<b>Control Signals</b>				
157	$\overline{\text{S0}}$	I	SSTL	<b>Chip Select of Rank 0</b>
158	$\overline{\text{S1}}$	I	SSTL	<b>Chip Select of Rank 1</b> <i>Note: 2-ranks module</i>
	NC	NC	—	<i>Note: 1-rank module</i>
154	$\overline{\text{RAS}}$	I	SSTL	<b>Row Address Strobe</b>
65	$\overline{\text{CAS}}$	I	SSTL	<b>Column Address Strobe</b>
63	$\overline{\text{WE}}$	I	SSTL	<b>Write Enable</b>
10	$\overline{\text{RESET}}$	I	LV-CMOS	<b>Register Reset</b>
<b>Address Signals</b>				
59	BA0	I	SSTL	<b>Bank Address Bus 1:0</b>
52	BA1	I	SSTL	
48	A0	I	SSTL	<b>Address Bus 11:0</b>
43	A1	I	SSTL	
41	A2	I	SSTL	
130	A3	I	SSTL	
37	A4	I	SSTL	
32	A5	I	SSTL	

Pin #	Name	Pin Type	Buffer Type	Function
125	A6	I	SSTL	<b>Address Bus 11:0</b>
29	A7	I	SSTL	
122	A8	I	SSTL	
27	A9	I	SSTL	
141	A10	I	SSTL	
	AP	I	SSTL	
118	A11	I	SSTL	<b>Address Signal 12</b> <i>Note: Module based on 256 Mbit or larger dies</i>
115	A12	I	SSTL	
	NC	NC	—	
167	A13	I	SSTL	<b>Address Signal 13</b> <i>Note: 1 Gbit based module</i>
	NC	NC	—	<i>Note: Module based on 512 Mbit or smaller dies</i>
<b>Data Signals</b>				
2	DQ0	I/O	SSTL	<b>Data Bus 63:0</b>
4	DQ1	I/O	SSTL	
6	DQ2	I/O	SSTL	
8	DQ3	I/O	SSTL	
94	DQ4	I/O	SSTL	
95	DQ5	I/O	SSTL	
98	DQ6	I/O	SSTL	
99	DQ7	I/O	SSTL	
12	DQ8	I/O	SSTL	
13	DQ9	I/O	SSTL	
19	DQ10	I/O	SSTL	
20	DQ11	I/O	SSTL	



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Pin #	Name	Pin Type	Buffer Type	Function
105	DQ12	I/O	SSTL	<b>Data Bus 63:0</b>
106	DQ13	I/O	SSTL	
109	DQ14	I/O	SSTL	
110	DQ15	I/O	SSTL	
23	DQ16	I/O	SSTL	
24	DQ17	I/O	SSTL	
28	DQ18	I/O	SSTL	
31	DQ19	I/O	SSTL	
114	DQ20	I/O	SSTL	
117	DQ21	I/O	SSTL	
121	DQ22	I/O	SSTL	
123	DQ23	I/O	SSTL	
33	DQ24	I/O	SSTL	
35	DQ25	I/O	SSTL	
39	DQ26	I/O	SSTL	
40	DQ27	I/O	SSTL	
126	DQ28	I/O	SSTL	
127	DQ29	I/O	SSTL	
131	DQ30	I/O	SSTL	
133	DQ31	I/O	SSTL	
53	DQ32	I/O	SSTL	
55	DQ33	I/O	SSTL	
57	DQ34	I/O	SSTL	
60	DQ35	I/O	SSTL	
146	DQ36	I/O	SSTL	
147	DQ37	I/O	SSTL	
150	DQ38	I/O	SSTL	
151	DQ39	I/O	SSTL	
61	DQ40	I/O	SSTL	
64	DQ41	I/O	SSTL	
68	DQ42	I/O	SSTL	
69	DQ43	I/O	SSTL	
153	DQ44	I/O	SSTL	
155	DQ45	I/O	SSTL	
161	DQ46	I/O	SSTL	
162	DQ47	I/O	SSTL	
72	DQ48	I/O	SSTL	
73	DQ49	I/O	SSTL	
79	DQ50	I/O	SSTL	
80	DQ51	I/O	SSTL	

Pin #	Name	Pin Type	Buffer Type	Function	
165	DQ52	I/O	SSTL	<b>Data Bus 63:0</b>	
166	DQ53	I/O	SSTL		
170	DQ54	I/O	SSTL		
171	DQ55	I/O	SSTL		
83	DQ56	I/O	SSTL		
84	DQ57	I/O	SSTL		
87	DQ58	I/O	SSTL		
88	DQ59	I/O	SSTL		
174	DQ60	I/O	SSTL		
175	DQ61	I/O	SSTL		
178	DQ62	I/O	SSTL		
179	DQ63	I/O	SSTL		
44	CB0	I/O	SSTL		<b>Check Bits 7:0</b>
45	CB1	I/O	SSTL		
49	CB2	I/O	SSTL		
51	CB3	I/O	SSTL		
134	CB4	I/O	SSTL		
135	CB5	I/O	SSTL		
142	CB6	I/O	SSTL		
144	CB7	I/O	SSTL		
5	DQS0	I/O	SSTL	<b>Data Strobes 8:0</b>	
14	DQS1	I/O	SSTL		
25	DQS2	I/O	SSTL		
36	DQS3	I/O	SSTL		
56	DQS4	I/O	SSTL		
67	DQS5	I/O	SSTL	<b>Data Strobes 8:0</b>	
78	DQS6	I/O	SSTL		
86	DQS7	I/O	SSTL		
47	DQS8	I/O	SSTL	<b>Data Mask 0</b> <i>Note: ×8 based module</i>	
97	DM0	I	SSTL		
	DQS9	I/O	SSTL	<b>Data Strobe 9</b> <i>Note: ×4 based module</i>	
107	DM1	I	SSTL	<b>Data Mask 1</b> <i>Note: ×8 based module</i>	
	DQS10	I/O	SSTL	<b>Data Strobe 10</b> <i>Note: ×4 based module</i>	



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Pin #	Name	Pin Type	Buffer Type	Function
119	DM2	I	SSTL	<b>Data Mask 2</b> <i>Note: x8 based module</i>
	DQS11	I/O	SSTL	<b>Data Strobe 11</b> <i>Note: x4 based module</i>
129	DM3	I	SSTL	<b>Data Mask 3</b> <i>Note: x8 based module</i>
	DQS12	I/O	SSTL	<b>Data Strobe 12</b> <i>Note: x4 based module</i>
149	DM4	I	SSTL	<b>Data Mask 4</b> <i>Note: x8 based module</i>
	DQS13	I/O	SSTL	<b>Data Strobe 13</b> <i>Note: x4 based module</i>
159	DM5	I	SSTL	<b>Data Mask 5</b> <i>Note: x8 based module</i>
	DQS14	I/O	SSTL	<b>Data Strobe 14</b> <i>Note: x4 based module</i>
169	DM6	I	SSTL	<b>Data Mask 6</b> <i>Note: x8 based module</i>
	DQS15	I/O	SSTL	<b>Data Strobe 15</b> <i>Note: x4 based module</i>
177	DM7	I	SSTL	<b>Data Mask 7</b> <i>Note: x8 based module</i>
	DQS16	I/O	SSTL	<b>Data Strobe 16</b> <i>Note: x4 based module</i>
140	DM8	I	SSTL	<b>Data Mask 8</b> <i>Note: x8 based module</i>
	DQS17	I/O	SSTL	<b>Data Strobe 17</b> <i>Note: x4 based module</i>
<b>E<sup>2</sup>PROM</b>				
92	SCL	I	CMOS	<b>Serial Bus Clock</b>
91	SDA	I/O	OD	<b>Serial Bus Data</b>
181	SA0	I	CMOS	<b>Slave Address Select Bus 2:0</b>
182	SA1	I	CMOS	
183	SA2	I	CMOS	
<b>Power Supplies</b>				
1	V <sub>REF</sub>	AI	—	<b>I/O Reference Voltage</b>
184	V <sub>DDSPD</sub>	PWR	—	<b>E<sup>2</sup>PROM Power Supply</b>

Pin #	Name	Pin Type	Buffer Type	Function
15, 22, 30, 54, 62, 77, 96, 104, 112, 128, 136, 143, 156, 164, 172, 180	V <sub>DDQ</sub>	PWR	—	<b>I/O Driver Power Supply</b>
7, 38, 46, 70, 85, 108, 120, 148, 168	V <sub>DD</sub>	PWR	—	<b>Power Supply</b>
3, 11, 18, 26, 34, 42, 50, 58, 66, 74, 81, 89, 93, 100, 116, 124, 132, 139, 145, 152, 160, 176	V <sub>SS</sub>	GND	—	<b>Ground Plane</b>





HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Pin #	Name	Pin Type	Buffer Type	Function
<b>Other Pins</b>				
82	$V_{DDID}$	O	OD	$V_{DD}$ Identification
9, 16, 17, 71, 75, 76, 90, 101, 102, 103, 113, 163, 173	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
NU	Not Usable (JEDEC Standard)
NC	Not Connected (JEDEC Standard)

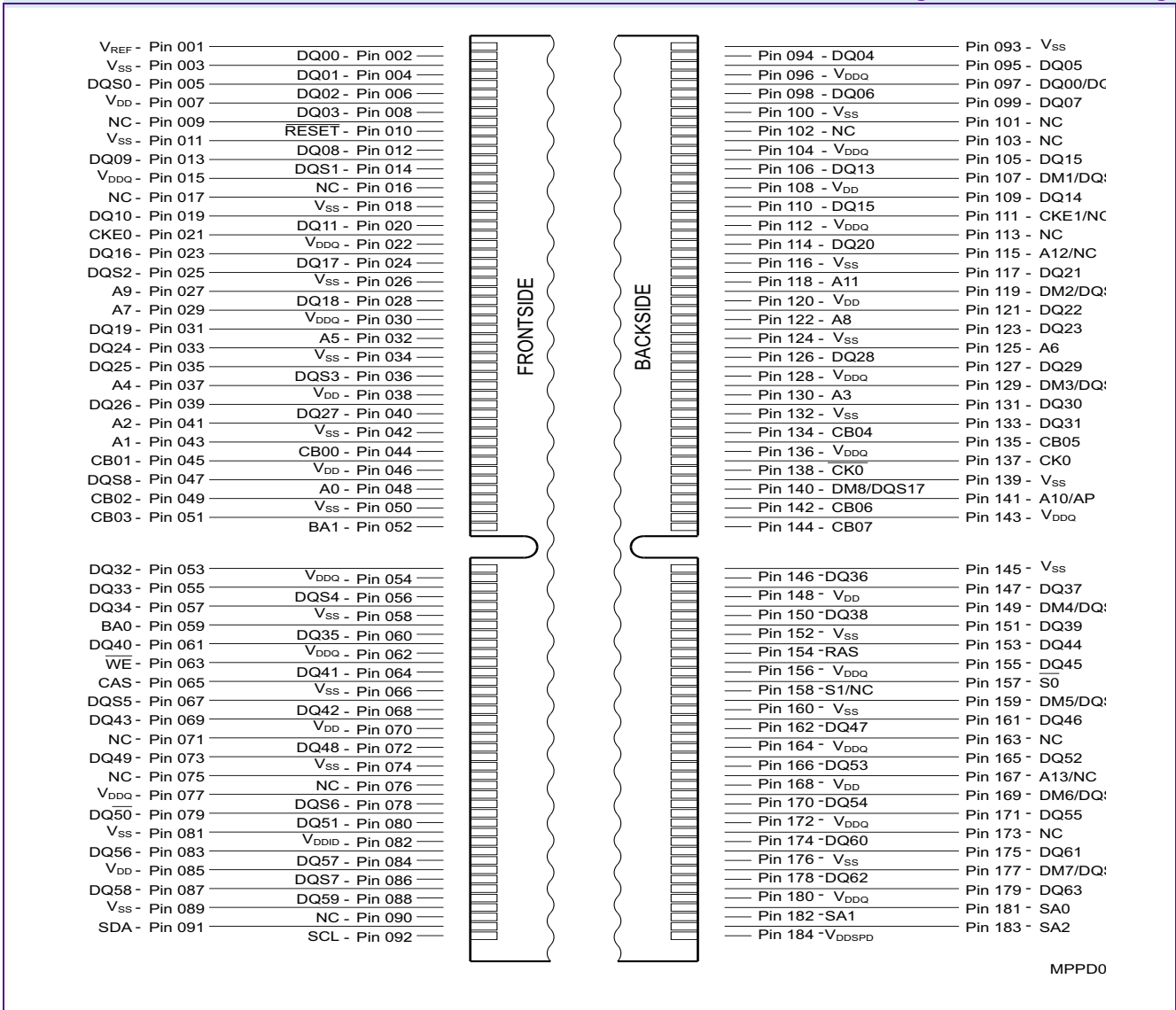
**TABLE 6**  
Abbreviations for Buffer Type

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.



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

**FIGURE 1**  
Pin Configuration 184 Pins, Reg



MPPD0

**TABLE 7**  
Address Table

Density	Organization	Memory Ranks	SDRAMs	# of SDRAMs	# of row/rank/ columns bits	Refresh	Period	Interval
256 MB	32 M x72	1	32 M x8	9	13 / 2 / 10	8 K	64 ms	7.8 μs
512 MB	64 M x72	1	64 M x4	18	13 / 2 / 11	8 K	64 ms	7.8 μs
512 MB	64 M x72	2	32 M x8	18	13 / 2 / 10	8 K	64 ms	7.8 μs
1 GB	128 M x72	2	64 M x4	36	13 / 2 / 11	8 K	64 ms	7.8 μs



# 3 Electrical Characteristics

This chapter lists the electrical characteristics.

## 3.1 Operating Conditions

This chapter contains the operating conditions tables.

**TABLE 8**  
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)	$P_D$	—	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 9**  
Electrical Characteristics and DC Operating Conditions

Parameter	Symbol	Values			Unit	Note <sup>1)</sup> /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 <sup>2)</sup>
Output Supply Voltage	$V_{DDQ}$	2.3	2.5	2.7	V	$f_{CK} \leq 166$ MHz <sup>3)</sup>
Output Supply Voltage	$V_{DDQ}$	2.5	2.6	2.7	V	$f_{CK} > 166$ MHz <sup>2)3)</sup>
E <sup>2</sup> PROM 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	$V_{REF}$	$0.49 \times V_{DDQ}$	$0.5 \times V_{DDQ}$	$0.51 \times V_{DDQ}$	V	<sup>4)</sup>
I/O Termination Voltage (System)	$V_{TT}$	$V_{REF} - 0.04$	—	$V_{REF} + 0.04$	V	<sup>5)</sup>



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

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

- 1)  $0^\circ C \leq T_A \leq 70^\circ C$
- 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  $\pm 2\% V_{REF(DC)}$ .  $V_{REF}$  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) Inputs are not recognized as valid until  $V_{REF}$  stabilizes.
- 7)  $V_{ID}$  is the magnitude of the difference between the input level on CK and the input level on  $\overline{CK}$ .
- 8) The ratio 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.
- 9) Values are shown per DDR SDRAM component



## 3.2 Current Conditions

This chapter describes the Conditions.

**TABLE 10**  
 **$I_{DD}$  Conditions**

Parameter	Symbol
<b>Operating Current 0</b> one bank; active/ precharge; DQ, DM, and DQS inputs changing once per clock cycle; address and control inputs changing once every two clock cycles.	$I_{DD0}$
<b>Operating Current 1</b> one bank; active/read/precharge; Burst Length = 4; see component data sheet.	$I_{DD1}$
<b>Precharge Power-Down Standby Current</b> all banks idle; power-down mode; $CKE \leq V_{IL,MAX}$	$I_{DD2P}$
<b>Precharge Floating Standby Current</b> $CS \geq V_{IH,MIN}$ , all banks idle; $CKE \geq V_{IH,MIN}$ ; address and other control inputs changing once per clock cycle; $V_{IN} = V_{REF}$ for DQ, DQS and DM.	$I_{DD2F}$
<b>Precharge Quiet Standby Current</b> $CS \geq V_{IH,MIN}$ , all banks idle; $CKE \geq V_{IH,MIN}$ ; $V_{IN} = V_{REF}$ for DQ, DQS and DM; address and other control inputs stable at $\geq V_{IH,MIN}$ or $\leq V_{IL,MAX}$ .	$I_{DD2Q}$
<b>Active Power-Down Standby Current</b> one bank active; power-down mode; $CKE \leq V_{IL,MAX}$ ; $V_{IN} = V_{REF}$ for DQ, DQS and DM.	$I_{DD3P}$
<b>Active Standby Current</b> one bank active; $CS \geq V_{IH,MIN}$ ; $CKE \geq V_{IH,MIN}$ ; $t_{RC} = t_{RAS,MAX}$ ; DQ, DM and DQS inputs changing twice per clock cycle; address and control inputs changing once per clock cycle.	$I_{DD3N}$
<b>Operating Current Read</b> 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	$I_{DD4R}$
<b>Operating Current Write</b> 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	$I_{DD4W}$
<b>Auto-Refresh Current</b> $t_{RC} = t_{RFCMIN}$ , burst refresh	$I_{DD5}$
<b>Self-Refresh Current</b> $CKE \leq 0.2$ V; external clock on	$I_{DD6}$
<b>Operating Current 7</b> four bank interleaving with Burst Length = 4; see component data sheet.	$I_{DD7}$



### 3.3 Current Specifications

This chapter describes the Specifications.

**TABLE 11**

**$I_{DD}$  Specification for HYS72D[128/64/32]3xx[G/H]BR-5-C**

Product Type	HYS72D32300GBR-5-C HYS72D32300HBR-5-C		HYS72D64300GBR-5-C HYS72D64300HBR-5-C		HYS72D64320GBR-5-C HYS72D64320HBR-5-C		Unit	Note/ Test Conditions <sup>1) 2)</sup>
	Organization	256 MB	512 MB	512 MB	×72	×72		
Symbol	Typ.	Max.	Typ.	Max.	Typ.	Max.		
$I_{DD0}$	1140	1370	2070	2480	1780	2080	mA	3)
$I_{DD1}$	1360	1600	2380	2800	2000	2310	mA	3)4)
$I_{DD2P}$	390	440	730	790	730	790	mA	5)
$I_{DD2F}$	880	990	1450	1620	1450	1620	mA	5)
$I_{DD2Q}$	540	650	1020	1200	1020	1200	mA	5)
$I_{DD3P}$	470	560	890	720	890	1020	mA	5)
$I_{DD3N}$	950	1080	1590	1780	1590	1780	mA	5)
$I_{DD4R}$	1400	1600	2470	2800	2040	2310	mA	3)4)
$I_{DD4W}$	1450	1650	2560	2890	2090	2350	mA	3)
$I_{DD5}$	1630	2120	3190	4130	2270	2830	mA	3)
$I_{DD6}$	330	370	640	700	640	700	mA	5)
$I_{DD7}$	2530	2950	4720	5500	3170	3660	mA	3)4)

- 1) Test condition for maximum values:  $V_{DD} = 2.7\text{ V}$ ,  $T_A = 10\text{ °C}$
- 2) Module  $I_{DD}$  is calculated on the basis of component  $I_{DD}$  and includes Register and PLL
- 3) The module  $I_{DD}$  values are calculated from the component  $I_{DD}$  datasheet values are:  $n * I_{DD} \times [\text{component}]$  for single bank modules (n: number of components per module bank)  $n * I_{DD} \times [\text{component}] + n * I_{DD3N} [\text{component}]$  for two bank modules (n: number of components per module bank)
- 4) DQ I/O ( $I_{DDQ}$ ) currents are not included into calculations: module  $I_{DD}$  values will be measured differently depending on load conditions
- 5) The module  $I_{DD}$  values are calculated from the component  $I_{DD}$  datasheet values are:  $n * I_{DD} \times [\text{component}]$  for single bank modules (n: number of components per module bank)  $2 * n * I_{DD} \times [\text{component}]$  for single two bank modules (n: number of components per module bank)



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**TABLE 12**

**$I_{DD}$  Specification for HYS72D[256/128/64/32]3xxx[G/H]BR-6-C**

Product Type	HYS72D32300GBR-6-C HYS72D32300HBR-6-C		HYS72D64300GBR-6-C HYS72D64300HBR-6-C		HYS72D64320GBR-6-C HYS72D64320HBR-6-C		HYS72D128320GBR-6-C HYS72D128320HBR-6-C		Unit	Note/ Test Conditions <sup>1) 2)</sup>
	256 MB		512 MB		512 MB		1 GB			
Organization	×72		×72		×72		×72			
	1 Rank		1 Rank		2 Ranks		2 Ranks			
	-6		-6		-6		-6			
	Symbol	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	
$I_{DD0}$	1000	1190	1790	2110	1540	1780	2870	3290	mA	<sup>3)</sup>
$I_{DD1}$	1210	1410	2090	2420	1750	2000	3160	3600	mA	<sup>3)4)</sup>
$I_{DD2P}$	370	410	650	710	650	710	1220	1300	mA	<sup>5)</sup>
$I_{DD2F}$	780	880	1250	1400	1250	1400	2200	2440	mA	<sup>5)</sup>
$I_{DD2Q}$	480	580	890	1050	890	1050	1690	1980	mA	<sup>5)</sup>
$I_{DD3P}$	430	500	780	640	780	890	1480	1660	mA	<sup>5)</sup>
$I_{DD3N}$	840	950	1380	1540	1380	1540	2450	2730	mA	<sup>5)</sup>
$I_{DD4R}$	1210	1410	2090	2420	1750	2000	3160	3600	mA	<sup>3)4)</sup>
$I_{DD4W}$	1250	1450	2180	2510	1790	2040	3250	3690	mA	<sup>3)</sup>
$I_{DD5}$	1420	1820	2750	3510	1960	2410	3830	4690	mA	<sup>3)</sup>
$I_{DD6}$	320	370	580	640	580	640	1110	1190	mA	<sup>5)</sup>
$I_{DD7}$	2200	2580	4070	4760	2740	3170	5140	5940	mA	<sup>3)4)</sup>

- 1) Test condition for maximum values:  $V_{DD} = 2.7\text{ V}$ ,  $T_A = 10\text{ °C}$
- 2) Module  $I_{DD}$  is calculated on the basis of component  $I_{DD}$  and includes Register and PLL
- 3) The module  $I_{DD}$  values are calculated from the component  $I_{DD}$  datasheet values are:  $n * I_{DD} \times [\text{component}]$  for single bank modules (n: number of components per module bank)  $n * I_{DD} \times [\text{component}] + n * I_{DD3N} [\text{component}]$  for two bank modules (n: number of components per module bank)
- 4) DQ I/O ( $I_{DDQ}$ ) currents are not included into calculations: module  $I_{DD}$  values will be measured differently depending on load conditions
- 5) The module  $I_{DD}$  values are calculated from the component  $I_{DD}$  datasheet values are:  $n * I_{DD} \times [\text{component}]$  for single bank modules (n: number of components per module bank)  $2 * n * I_{DD} \times [\text{component}]$  for single two bank modules (n: number of components per module bank)



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**TABLE 13**

**$I_{DD}$  Specification for HYS72D[128/64/32]3xxx[G/H]BR-7-C**

Product Type	HYS72D32300GBR-7-C HYS72D32300HBR-7-C		HYS72D64300GBR-7-C HYS72D64300HBR-7-C		HYS72D128320GBR-7-C HYS72D128320HBR-7-C		Unit	Note/ Test Conditions <sup>1) 2)</sup>
	Organization	256 MB	512 MB	1 GB				
	×72	×72	×72					
	1 Rank	1 Rank	1 Rank	2 Ranks				
	-7	-7	-7					
Symbol	Typ.	Max.	Typ.	Max.	Typ.	Max.		
$I_{DD0}$	860	1040	1510	1830	2410	2870	mA	3)
$I_{DD1}$	1100	1250	1890	2120	2790	3170	mA	3)4)
$I_{DD2P}$	330	370	560	610	1010	1080	mA	5)
$I_{DD2F}$	670	760	1050	1180	1810	2010	mA	5)
$I_{DD2Q}$	440	520	770	910	1440	1690	mA	5)
$I_{DD3P}$	380	450	660	570	1230	1400	mA	5)
$I_{DD3N}$	740	870	1200	1390	2100	2440	mA	5)
$I_{DD4R}$	1060	1200	1800	2030	2700	3080	mA	3)4)
$I_{DD4W}$	1100	1250	1890	2120	2790	3170	mA	3)
$I_{DD5}$	1210	1600	2310	3060	3210	4110	mA	3)
$I_{DD6}$	300	350	520	580	940	1030	mA	5)
$I_{DD7}$	1780	2100	3240	3830	4140	4880	mA	3)4)

- 1) Test condition for maximum values:  $V_{DD} = 2.7\text{ V}$ ,  $T_A = 10\text{ °C}$
- 2) Module  $I_{DD}$  is calculated on the basis of component  $I_{DD}$  and includes Register and PLL
- 3) The module  $I_{DD}$  values are calculated from the component  $I_{DD}$  datasheet values are:  $n * I_{DD} \times [\text{component}]$  for single bank modules (n: number of components per module bank)  $n * I_{DD} \times [\text{component}] + n * I_{DD3N} [\text{component}]$  for two bank modules (n: number of components per module bank)
- 4) DQ I/O ( $I_{DDQ}$ ) currents are not included into calculations: module  $I_{DD}$  values will be measured differently depending on load conditions
- 5) The module  $I_{DD}$  values are calculated from the component  $I_{DD}$  datasheet values are:  $n * I_{DD} \times [\text{component}]$  for single bank modules (n: number of components per module bank)  $2 * n * I_{DD} \times [\text{component}]$  for single two bank modules (n: number of components per module bank)





### 3.4 AC Characteristics

This chapter describes the AC characteristics.

**TABLE 14**

**AC Timing - Absolute Specifications for PC3200 and PC2700**

Parameter	Symbol	-5		-6		Unit	Note/ Test Condition <sup>1)</sup>
		DDR400B		DDR333			
		Min.	Max.	Min.	Max.		
DQ output access time from $\overline{CK}/\overline{CK}$	$t_{AC}$	-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	$t_{DAL}$	(tWR/tCK)+(tRP/tCK)				$t_{CK}$	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)6)
DQS output access time from $\overline{CK}/\overline{CK}$	$t_{DQSK}$	-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	—	+0.40	ns	TFBGA 2)3)4)5)
Write command to 1 <sup>st</sup> 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 $\overline{CK}/\overline{CK}$	$t_{HZ}$	—	+0.7	-0.7	+0.7	ns	2)3)4)5)6)
Address and control input hold time	$t_{IH}$	0.6	—	0.75	—	ns	fast slew rate 3)4)5)6)7)
		0.7	—	0.8	—	ns	slow slew rate 3)4)5)6)7)
Control and Addr. input pulse width (each input)	$t_{IPW}$	2.2	—	2.2	—	ns	2)3)4)5)8)



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Parameter	Symbol	-5		-6		Unit	Note/ Test Condition <sup>1)</sup>
		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)7)
		0.7	—	0.8	—	ns	slow slew rate 3)4)5)6)7)
Data-out low-impedance time from CK/CK	$t_{LZ}$	-0.7	+0.7	-0.7	+0.7	ns	2)3)4)5)6)
Mode register set command cycle time	$t_{MRD}$	2	—	2	—	$t_{CK}$	2)3)4)5)
DQ/DQS output hold time	$t_{QH}$	$t_{HP} - t_{QHS}$	—	$t_{HP} - t_{QHS}$	—	ns	2)3)4)5)
Data hold skew factor	$t_{QHS}$	—	+0.50	—	+0.50	ns	TFBGA 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	$\mu$ s	2)3)4)5)9)
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)8)
Write postamble	$t_{WPST}$	0.40	0.60	0.40	0.60	$t_{CK}$	2)3)4)5)8)
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)  $0\text{ }^{\circ}\text{C} \leq T_A \leq 70\text{ }^{\circ}\text{C}$ ;  $V_{DDQ} = 2.5\text{ V} \pm 0.2\text{ V}$ ,  $V_{DD} = +2.5\text{ V} \pm 0.2\text{ V}$  (DDR333);  $V_{DDQ} = 2.6\text{ V} \pm 0.1\text{ V}$ ,  $V_{DD} = +2.6\text{ V} \pm 0.1\text{ V}$  (DDR400)
- 2) Input slew rate  $\geq 1\text{ V/ns}$  for DDR400, DDR333
- 3) The CK/ $\overline{\text{CK}}$  input reference level (for timing reference to CK/ $\overline{\text{CK}}$ ) is the point at which CK and  $\overline{\text{CK}}$  cross: the input reference level for signals other than CK/ $\overline{\text{CK}}$ , is  $V_{REF}$ . CK/ $\overline{\text{CK}}$  slew rate are  $\geq 1.0\text{ V/ns}$ .
- 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) Fast slew rate  $\geq 1.0\text{ V/ns}$ , slow slew rate  $\geq 0.5\text{ V/ns}$  and  $< 1\text{ V/ns}$  for command/address and CK &  $\overline{\text{CK}}$  slew rate  $> 1.0\text{ V/ns}$ , measured between  $V_{IH(ac)}$  and  $V_{IL(ac)}$ .
- 8) These parameters guarantee device timing, but they are not necessarily tested on each device.
- 9) A maximum of eight Autorefresh commands can be posted to any given DDR SDRAM device.



**TABLE 15**

**AC Timing - Absolute Specifications for PC2700**

Parameter	Symbol	-7		Unit	Note/Test Condition <sup>1)</sup>
		DDR266A			
		Min.	Max.		
DQ output access time from $\overline{\text{CK}}/\overline{\text{CK}}$	$t_{AC}$	-0.75	+0.75	ns	2)3)4)5)
CK high-level width	$t_{CH}$	0.45	0.55	$t_{CK}$	2)3)4)5)
Clock cycle time	$t_{CK}$	7.5	12	ns	CL = 2.5 <sup>2)3)4)5)</sup>
		7.5	12	ns	CL = 2.0 <sup>2)3)4)5)</sup>
CK low-level width	$t_{CL}$	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	$t_{DH}$	0.5	—	ns	2)3)4)5)
DQ and DM input pulse width (each input)	$t_{DIPW}$	1.75	—	ns	2)3)4)5)
DQS output access time from $\overline{\text{CK}}/\overline{\text{CK}}$	$t_{DQSCK}$	-0.75	+0.75	ns	2)3)4)5)
DQS input low (high) pulse width (write cycle)	$t_{DQSL,H}$	0.35	—	$t_{CK}$	2)3)4)5)
DQS-DQ skew (DQS and associated DQ signals)	$t_{DQSQ}$	—	+0.5	ns	FBGA <sup>2)3)4)5)</sup>
Write command to 1 <sup>st</sup> DQS latching transition	$t_{DQSS}$	0.75	1.25	$t_{CK}$	2)3)4)5)
DQ and DM input setup time	$t_{DS}$	0.5	—	ns	2)3)4)5)
DQS falling edge hold time from CK (write cycle)	$t_{DSH}$	0.2	—	$t_{CK}$	2)3)4)5)
DQS falling edge to CK setup time (write cycle)	$t_{DSS}$	0.2	—	$t_{CK}$	2)3)4)5)
Clock Half Period	$t_{HP}$	min. ( $t_{CL}, t_{CH}$ )	—	ns	2)3)4)5)
Data-out high-impedance time from $\overline{\text{CK}}/\overline{\text{CK}}$	$t_{HZ}$	-0.75	+0.75	ns	2)3)4)5)6)
Address and control input hold time	$t_{IH}$	0.9	—	ns	fast slew rate 3)4)5)6)7)
		1.0	—	ns	slow slew rate 3)4)5)6)8)
Control and Addr. input pulse width (each input)	$t_{IPW}$	2.2	—	ns	2)3)4)5)8)
Address and control input setup time	$t_{IS}$	0.9	—	ns	fast slew rate 3)4)5)6)8)
		1.0	—	ns	slow slew rate 3)4)5)6)8)
Data-out low-impedance time from $\overline{\text{CK}}/\overline{\text{CK}}$	$t_{LZ}$	-0.75	+0.75	ns	2)3)4)5)6)
Mode register set command cycle time	$t_{MRD}$	2	—	$t_{CK}$	2)3)4)5)
DQ/DQS output hold time	$t_{QH}$	$t_{HP} - t_{QHS}$	—	ns	2)3)4)5)
Data hold skew factor	$t_{QHS}$	—	0.75	ns	FBGA <sup>2)3)4)5)</sup>
Active to Read w/AP delay	$t_{RAP}$	$t_{RCD}$ OR $t_{RASmin}$	—	ns	2)3)4)5)
Active to Precharge command	$t_{RAS}$	45	120E+3	ns	2)3)4)5)
Active to Active/Auto-refresh command period	$t_{RC}$	65	—	ns	2)3)4)5)
Active to Read or Write delay	$t_{RCD}$	20	—	ns	2)3)4)5)
Average Periodic Refresh Interval	$t_{REFI}$	7.8	—	μs	2)3)4)5)8)
Auto-refresh to Active/Auto-refresh command period	$t_{RFC}$	75	—	ns	2)3)4)5)



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Parameter	Symbol	-7		Unit	Note/Test Condition <sup>1)</sup>
		DDR266A			
		Min.	Max.		
Precharge command period	$t_{RP}$	20	—	ns	2)3)4)5)
Read preamble	$t_{RPRE}$	0.9	1.1	$t_{CK}$	2)3)4)5)
Read postamble	$t_{RPST}$	0.4	0.6	$t_{CK}$	2)3)4)5)
Active bank A to Active bank B command	$t_{RRD}$	15	—	ns	2)3)4)5)
Write preamble	$t_{WPRE}$	0.25	—	$t_{CK}$	2)3)4)5)
Write preamble setup time	$t_{WPRES}$	0	—	ns	2)3)4)5)9)
Write postamble	$t_{WPST}$	0.4	—	$t_{CK}$	2)3)4)5)10)
Write recovery time	$t_{WR}$	15	—	ns	2)3)4)5)
Internal write to read command delay	$t_{WTR}$	1	—	$t_{CK}$	2)3)4)5)
Exit self-refresh to non-read command	$t_{XSNR}$	75	—	ns	2)3)4)5)11)
Exit self-refresh to read command	$t_{XSRD}$	200	—	$t_{CK}$	2)3)4)5)

- 1)  $V_{DDQ} = 2.5\text{ V} \pm 0.2\text{ V}$ ,  $V_{DD} = +2.5\text{ V} \pm 0.2\text{ V}$ ;  $0\text{ }^{\circ}\text{C} \leq T_A \leq 70\text{ }^{\circ}\text{C}$
- 2) Input slew rate  $\geq 1\text{ V/ns}$
- 3) The CK/ $\overline{\text{CK}}$  input reference level (for timing reference to CK/ $\overline{\text{CK}}$ ) is the point at which CK and  $\overline{\text{CK}}$  cross: the input reference level for signals other than CK/ $\overline{\text{CK}}$ , is  $V_{REF}$ . CK/ $\overline{\text{CK}}$  slew rate are  $\geq 1.0\text{ V/ns}$ .
- 4) Inputs are not recognized as valid until  $\overline{\text{CS}}$  stabilizes.
- 5) The Output timing reference level, as measured at the timing reference point indicated in AC Characteristics (note 3) is  $V_{TT}$ .
- 6)  $t_{HZ}$  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).
- 7) Fast slew rate  $\geq 1.0\text{ V/ns}$ , slow slew rate  $\geq 0.5\text{ V/ns}$  and  $< 1\text{ V/ns}$  for command/address and CK &  $\overline{\text{CK}}$  slew rate  $> 1.0\text{ V/ns}$ , measured between  $V_{IH(ac)}$  and  $V_{IL(ac)}$ .
- 8) A maximum of eight Autorefresh commands can be posted to any given DDR SDRAM device.
- 9) 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  $t_{DQSS}$ .
- 10) 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.
- 11) In all circumstances,  $t_{XSNR}$  can be satisfied using  $t_{XSNR} = t_{RFC,min} + 1 \times t_{CK}$



# 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 16 “HYS72D[32/64]3x0GBR-5-C” on Page 21
- Table 17 “HYS72D[32/64/128]3x0GBR-6-C” on Page 25
- Table 18 “HYS72D[32/64/128]3x0GBR-7-C” on Page 29
- Table 19 “HYS72D[32/64]3x0HBR-5-C” on Page 33
- Table 20 “HYS72D[32/64/128]3x0HBR-6-C” on Page 37
- Table 21 “HYS72D[32/64/128]3x0HBR-7-C” on Page 41

**TABLE 16**  
HYS72D[32/64]3x0GBR-5-C

Product Type		HYS72D32300GBR-5-C	HYS72D64300GBR-5-C	HYS72D64320GBR-5-C
Organization		256MB	512MB	512MB
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)
Label Code		PC3200R-30331	PC3200R-30331	PC3200R-30331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX
0	Programmed SPD Bytes in E2PROM	80	80	80
1	Total number of Bytes in E2PROM	08	08	08
2	Memory Type (DDR = 07h)	07	07	07
3	Number of Row Addresses	0D	0D	0D
4	Number of Column Addresses	0A	0B	0A
5	Number of DIMM Ranks	01	01	02
6	Data Width (LSB)	48	48	48
7	Data Width (MSB)	00	00	00
8	Interface Voltage Levels	04	04	04
9	t <sub>CK</sub> @ CL <sub>max</sub> (Byte 18) [ns]	50	50	50
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (Byte 18) [ns]	50	50	50



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300GBR-5-C	HYS72D64300GBR-5-C	HYS72D64320GBR-5-C
Organization		256MB	512MB	512MB
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)
Label Code		PC3200R-30331	PC3200R-30331	PC3200R-30331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX
11	Error Correction Support	02	02	02
12	Refresh Rate	82	82	82
13	Primary SDRAM Width	08	04	08
14	Error Checking SDRAM Width	08	04	08
15	t <sub>CCD</sub> [cycles]	01	01	01
16	Burst Length Supported	0E	0E	0E
17	Number of Banks on SDRAM Device	04	04	04
18	CAS Latency	1C	1C	1C
19	CS Latency	01	01	01
20	Write Latency	02	02	02
21	DIMM Attributes	26	26	26
22	Component Attributes	C1	C1	C1
23	t <sub>CK @ CL<sub>max</sub> -0.5 (Byte 18) [ns]</sub>	60	60	60
24	t <sub>AC SDRAM @ CL<sub>max</sub> -0.5 [ns]</sub>	50	50	50
25	t <sub>CK @ CL<sub>max</sub> -1 (Byte 18) [ns]</sub>	75	75	75
26	t <sub>AC SDRAM @ CL<sub>max</sub> -1 [ns]</sub>	50	50	50
27	t <sub>RPmin</sub> [ns]	3C	3C	3C
28	t <sub>RRDmin</sub> [ns]	28	28	28
29	t <sub>RCDmin</sub> [ns]	3C	3C	3C
30	t <sub>RASmin</sub> [ns]	28	28	28
31	Module Density per Rank	40	80	40
32	t <sub>AS</sub> , t <sub>CS</sub> [ns]	60	60	60
33	t <sub>AH</sub> , t <sub>CH</sub> [ns]	60	60	60
34	t <sub>DS</sub> [ns]	40	40	40
35	t <sub>DH</sub> [ns]	40	40	40
36 - 40	Not used	00	00	00
41	t <sub>RCmin</sub> [ns]	37	37	37



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300GBR-5-C	HYS72D64300GBR-5-C	HYS72D64320GBR-5-C
Organization		256MB	512MB	512MB
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)
Label Code		PC3200R-30331	PC3200R-30331	PC3200R-30331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX
42	t <sub>RFCmin</sub> [ns]	41	41	41
43	t <sub>CKmax</sub> [ns]	28	28	28
44	t <sub>DQSQmax</sub> [ns]	28	28	28
45	t <sub>QHSmax</sub> [ns]	50	50	50
46	not used	00	00	00
47	DIMM PCB Height	01	01	01
48 - 61	Not used	00	00	00
62	SPD Revision	10	10	10
63	Checksum of Byte 0-62	26	5F	27
64	Manufacturer's JEDEC ID Code (1)	7F	7F	7F
65	Manufacturer's JEDEC ID Code (2)	7F	7F	7F
66	Manufacturer's JEDEC ID Code (3)	7F	7F	7F
67	Manufacturer's JEDEC ID Code (4)	7F	7F	7F
68	Manufacturer's JEDEC ID Code (5)	7F	7F	7F
69	Manufacturer's JEDEC ID Code (6)	51	51	51
70	Manufacturer's JEDEC ID Code (7)	00	00	00
71	Manufacturer's JEDEC ID Code (8)	00	00	00
72	Module Manufacturer Location	xx	xx	xx
73	Part Number, Char 1	37	37	37
74	Part Number, Char 2	32	32	32
75	Part Number, Char 3	44	44	44
76	Part Number, Char 4	33	36	36
77	Part Number, Char 5	32	34	34
78	Part Number, Char 6	33	33	33
79	Part Number, Char 7	30	30	32
80	Part Number, Char 8	30	30	30
81	Part Number, Char 9	47	47	47



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300GBR-5-C	HYS72D64300GBR-5-C	HYS72D64320GBR-5-C
Organization		256MB	512MB	512MB
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)
Label Code		PC3200R-30331	PC3200R-30331	PC3200R-30331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX
82	Part Number, Char 10	42	42	42
83	Part Number, Char 11	52	52	52
84	Part Number, Char 12	35	35	35
85	Part Number, Char 13	43	43	43
86	Part Number, Char 14	20	20	20
87	Part Number, Char 15	20	20	20
88	Part Number, Char 16	20	20	20
89	Part Number, Char 17	20	20	20
90	Part Number, Char 18	20	20	20
91	Module Revision Code	1x	1x	1x
92	Test Program Revision Code	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx
99 - 127	Not used	00	00	00





HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

**TABLE 17**  
**HYS72D[32/64/128]3x0GBR-6-C**

Product Type		HYS72D32300GBR-6-C	HYS72D64300GBR-6-C	HYS72D64320GBR-6-C	HYS72D128320GBR-6-C
Organization		256MB	512MB	512MB	1 GByte
		×72	×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)	2 Ranks (×4)
Label Code		PC2700R-25330	PC2700R-25330	PC2700R-25330	PC2700R-25330
JEDEC SPD Revision		Rev. 0.0	Rev. 0.0	Rev. 0.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX	HEX
0	Programmed SPD Bytes in E2PROM	80	80	80	80
1	Total number of Bytes in E2PROM	08	08	08	08
2	Memory Type (DDR = 07h)	07	07	07	07
3	Number of Row Addresses	0D	0D	0D	0D
4	Number of Column Addresses	0A	0B	0A	0B
5	Number of DIMM Ranks	01	01	02	02
6	Data Width (LSB)	48	48	48	48
7	Data Width (MSB)	00	00	00	00
8	Interface Voltage Levels	04	04	04	04
9	t <sub>CK</sub> @ CL <sub>max</sub> (Byte 18) [ns]	60	60	60	60
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (Byte 18) [ns]	70	70	70	70
11	Error Correction Support	02	02	02	02
12	Refresh Rate	82	82	82	82
13	Primary SDRAM Width	08	04	08	04
14	Error Checking SDRAM Width	08	04	08	04
15	t <sub>CCD</sub> [cycles]	01	01	01	01
16	Burst Length Supported	0E	0E	0E	0E
17	Number of Banks on SDRAM Device	04	04	04	04
18	CAS Latency	0C	0C	0C	0C
19	CS Latency	01	01	01	01
20	Write Latency	02	02	02	02
21	DIMM Attributes	26	26	26	26
22	Component Attributes	C1	C1	C1	C1



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300GBR-6-C	HYS72D64300GBR-6-C	HYS72D64320GBR-6-C	HYS72D128320GBR-6-C
Organization		256MB	512MB	512MB	1 GByte
		×72	×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)	2 Ranks (×4)
Label Code		PC2700R-25330	PC2700R-25330	PC2700R-25330	PC2700R-25330
JEDEC SPD Revision		Rev. 0.0	Rev. 0.0	Rev. 0.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX	HEX
23	t <sub>CK</sub> @ CL <sub>max</sub> -0.5 (Byte 18) [ns]	75	75	75	75
24	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -0.5 [ns]	70	70	70	70
25	t <sub>CK</sub> @ CL <sub>max</sub> -1 (Byte 18) [ns]	00	00	00	00
26	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -1 [ns]	00	00	00	00
27	t <sub>RPmin</sub> [ns]	48	48	48	48
28	t <sub>RRDmin</sub> [ns]	30	30	30	30
29	t <sub>RCDmin</sub> [ns]	48	48	48	48
30	t <sub>RASmin</sub> [ns]	2A	2A	2A	2A
31	Module Density per Rank	40	80	40	80
32	t <sub>AS</sub> , t <sub>CS</sub> [ns]	75	75	75	75
33	t <sub>AH</sub> , t <sub>CH</sub> [ns]	75	75	75	75
34	t <sub>DS</sub> [ns]	45	45	45	45
35	t <sub>DH</sub> [ns]	45	45	45	45
36 - 40	Not used	00	00	00	00
41	t <sub>RCmin</sub> [ns]	3C	3C	3C	3C
42	t <sub>RFCmin</sub> [ns]	48	48	48	48
43	t <sub>CKmax</sub> [ns]	30	30	30	30
44	t <sub>DQSQmax</sub> [ns]	28	28	28	28
45	t <sub>QHSmax</sub> [ns]	50	50	50	50
46	not used	00	00	00	00
47	DIMM PCB Height	00	00	00	00
48 - 61	Not used	00	00	00	00
62	SPD Revision	00	00	00	00
63	Checksum of Byte 0-62	0F	48	10	49
64	Manufacturer's JEDEC ID Code (1)	7F	7F	7F	7F



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300GBR-6-C	HYS72D64300GBR-6-C	HYS72D64320GBR-6-C	HYS72D128320GBR-6-C
Organization		256MB	512MB	512MB	1 GByte
		×72	×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)	2 Ranks (×4)
Label Code		PC2700R-25330	PC2700R-25330	PC2700R-25330	PC2700R-25330
JEDEC SPD Revision		Rev. 0.0	Rev. 0.0	Rev. 0.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX	HEX
65	Manufacturer's JEDEC ID Code (2)	7F	7F	7F	7F
66	Manufacturer's JEDEC ID Code (3)	7F	7F	7F	7F
67	Manufacturer's JEDEC ID Code (4)	7F	7F	7F	7F
68	Manufacturer's JEDEC ID Code (5)	7F	7F	7F	7F
69	Manufacturer's JEDEC ID Code (6)	51	51	51	51
70	Manufacturer's JEDEC ID Code (7)	00	00	00	00
71	Manufacturer's JEDEC ID Code (8)	00	00	00	00
72	Module Manufacturer Location	xx	xx	xx	xx
73	Part Number, Char 1	37	37	37	37
74	Part Number, Char 2	32	32	32	32
75	Part Number, Char 3	44	44	44	44
76	Part Number, Char 4	33	36	36	31
77	Part Number, Char 5	32	34	34	32
78	Part Number, Char 6	33	33	33	38
79	Part Number, Char 7	30	30	32	33
80	Part Number, Char 8	30	30	30	32
81	Part Number, Char 9	47	47	47	30
82	Part Number, Char 10	42	42	42	47
83	Part Number, Char 11	52	52	52	42
84	Part Number, Char 12	36	36	36	52
85	Part Number, Char 13	43	43	43	36
86	Part Number, Char 14	20	20	20	43
87	Part Number, Char 15	20	20	20	20
88	Part Number, Char 16	20	20	20	20
89	Part Number, Char 17	20	20	20	20



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

<b>Product Type</b>		<b>HYS72D32300GBR-6-C</b>	<b>HYS72D64300GBR-6-C</b>	<b>HYS72D64320GBR-6-C</b>	<b>HYS72D128320GBR-6-C</b>
<b>Organization</b>		<b>256MB</b>	<b>512MB</b>	<b>512MB</b>	<b>1 GByte</b>
		<b>×72</b>	<b>×72</b>	<b>×72</b>	<b>×72</b>
		<b>1 Rank (×8)</b>	<b>1 Rank (×4)</b>	<b>2 Ranks (×8)</b>	<b>2 Ranks (×4)</b>
<b>Label Code</b>		<b>PC2700R-25330</b>	<b>PC2700R-25330</b>	<b>PC2700R-25330</b>	<b>PC2700R-25330</b>
<b>JEDEC SPD Revision</b>		<b>Rev. 0.0</b>	<b>Rev. 0.0</b>	<b>Rev. 0.0</b>	<b>Rev. 0.0</b>
<b>Byte#</b>	<b>Description</b>	<b>HEX</b>	<b>HEX</b>	<b>HEX</b>	<b>HEX</b>
90	Part Number, Char 18	20	20	20	20
91	Module Revision Code	1x	1x	1x	1x
92	Test Program Revision Code	xx	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx	xx
99 - 127	Not used	00	00	00	00



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

**TABLE 18**  
**HYS72D[32/64/128]3x0GBR-7-C**

Product Type		HYS72D32300GBR-7-C	HYS72D64300GBR-7-C	HYS72D128320GBR-7-C
Organization		256MB	512MB	1 GByte
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×4)
Label Code		PC2100R-20330	PC2100R-20331	PC2100R-20330
JEDEC SPD Revision		Rev. 0.0	Rev. 1.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX
0	Programmed SPD Bytes in E2PROM	80	80	80
1	Total number of Bytes in E2PROM	08	08	08
2	Memory Type (DDR = 07h)	07	07	07
3	Number of Row Addresses	0D	0D	0D
4	Number of Column Addresses	0A	0B	0B
5	Number of DIMM Ranks	01	01	02
6	Data Width (LSB)	48	48	48
7	Data Width (MSB)	00	00	00
8	Interface Voltage Levels	04	04	04
9	t <sub>CK</sub> @ CL <sub>max</sub> (Byte 18) [ns]	70	70	70
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (Byte 18) [ns]	75	75	75
11	Error Correction Support	02	02	02
12	Refresh Rate	82	82	82
13	Primary SDRAM Width	08	04	04
14	Error Checking SDRAM Width	08	04	04
15	t <sub>CCD</sub> [cycles]	01	01	01
16	Burst Length Supported	0E	0E	0E
17	Number of Banks on SDRAM Device	04	04	04
18	CAS Latency	0C	0C	0C
19	CS Latency	01	01	01
20	Write Latency	02	02	02
21	DIMM Attributes	26	26	26
22	Component Attributes	C1	C1	C1
23	t <sub>CK</sub> @ CL <sub>max</sub> -0.5 (Byte 18) [ns]	75	75	75



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300GBBR-7-C	HYS72D64300GBBR-7-C	HYS72D128320GBBR-7-C
Organization		256MB	512MB	1 GByte
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×4)
Label Code		PC2100R-20330	PC2100R-20331	PC2100R-20330
JEDEC SPD Revision		Rev. 0.0	Rev. 1.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX
24	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -0.5 [ns]	75	75	75
25	t <sub>CK</sub> @ CL <sub>max</sub> -1 (Byte 18) [ns]	00	00	00
26	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -1 [ns]	00	00	00
27	t <sub>RPmin</sub> [ns]	50	50	50
28	t <sub>RRDmin</sub> [ns]	3C	3C	3C
29	t <sub>RCDmin</sub> [ns]	50	50	50
30	t <sub>RASmin</sub> [ns]	2D	2D	2D
31	Module Density per Rank	40	80	80
32	t <sub>AS</sub> , t <sub>CS</sub> [ns]	90	90	90
33	t <sub>AH</sub> , t <sub>CH</sub> [ns]	90	90	90
34	t <sub>DS</sub> [ns]	50	50	50
35	t <sub>DH</sub> [ns]	50	50	50
36 - 40	Not used	00	00	00
41	t <sub>RCmin</sub> [ns]	41	41	41
42	t <sub>RFCmin</sub> [ns]	4B	4B	4B
43	t <sub>CKmax</sub> [ns]	30	30	30
44	t <sub>DQSQmax</sub> [ns]	32	32	32
45	t <sub>QHSmax</sub> [ns]	75	75	75
46	not used	00	00	00
47	DIMM PCB Height	00	00	00
48 - 61	Not used	00	00	00
62	SPD Revision	00	10	00
63	Checksum of Byte 0-62	CB	14	05
64	Manufacturer's JEDEC ID Code (1)	7F	7F	7F
65	Manufacturer's JEDEC ID Code (2)	7F	7F	7F
66	Manufacturer's JEDEC ID Code (3)	7F	7F	7F



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300GBR-7-C	HYS72D64300GBR-7-C	HYS72D128320GBR-7-C
Organization		256MB	512MB	1 GByte
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×4)
Label Code		PC2100R-20330	PC2100R-20331	PC2100R-20330
JEDEC SPD Revision		Rev. 0.0	Rev. 1.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX
67	Manufacturer's JEDEC ID Code (4)	7F	7F	7F
68	Manufacturer's JEDEC ID Code (5)	7F	7F	7F
69	Manufacturer's JEDEC ID Code (6)	51	51	51
70	Manufacturer's JEDEC ID Code (7)	00	00	00
71	Manufacturer's JEDEC ID Code (8)	00	00	00
72	Module Manufacturer Location	xx	xx	xx
73	Part Number, Char 1	37	37	37
74	Part Number, Char 2	32	32	32
75	Part Number, Char 3	44	44	44
76	Part Number, Char 4	33	36	31
77	Part Number, Char 5	32	34	32
78	Part Number, Char 6	33	33	38
79	Part Number, Char 7	30	30	33
80	Part Number, Char 8	30	30	32
81	Part Number, Char 9	47	47	30
82	Part Number, Char 10	42	42	47
83	Part Number, Char 11	52	52	42
84	Part Number, Char 12	37	37	52
85	Part Number, Char 13	43	43	37
86	Part Number, Char 14	20	20	43
87	Part Number, Char 15	20	20	20
88	Part Number, Char 16	20	20	20
89	Part Number, Char 17	20	20	20
90	Part Number, Char 18	20	20	20
91	Module Revision Code	1x	0x	1x
92	Test Program Revision Code	xx	xx	xx



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300GBR-7-C	HYS72D64300GBR-7-C	HYS72D128320GBR-7-C
Organization		256MB	512MB	1 GByte
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×4)
Label Code		PC2100R-20330	PC2100R-20331	PC2100R-20330
JEDEC SPD Revision		Rev. 0.0	Rev. 1.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX
93	Module Manufacturing Date Year	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx
99 - 127	Not used	00	00	00





HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

**TABLE 19**  
HYS72D[32/64]3x0HBR-5-C

Product Type		HYS72D32300HBR-5-C	HYS72D64300HBR-5-C	HYS72D64320HBR-5-C
Organization		256MB	512MB	512MB
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)
Label Code		PC3200R-30331	PC3200R-30331	PC3200R-30331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX
0	Programmed SPD Bytes in E2PROM	80	80	80
1	Total number of Bytes in E2PROM	08	08	08
2	Memory Type (DDR = 07h)	07	07	07
3	Number of Row Addresses	0D	0D	0D
4	Number of Column Addresses	0A	0B	0A
5	Number of DIMM Ranks	01	01	02
6	Data Width (LSB)	48	48	48
7	Data Width (MSB)	00	00	00
8	Interface Voltage Levels	04	04	04
9	t <sub>CK</sub> @ CL <sub>max</sub> (Byte 18) [ns]	50	50	50
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (Byte 18) [ns]	50	50	50
11	Error Correction Support	02	02	02
12	Refresh Rate	82	82	82
13	Primary SDRAM Width	08	04	08
14	Error Checking SDRAM Width	08	04	08
15	t <sub>CCD</sub> [cycles]	01	01	01
16	Burst Length Supported	0E	0E	0E
17	Number of Banks on SDRAM Device	04	04	04
18	CAS Latency	1C	1C	1C
19	CS Latency	01	01	01
20	Write Latency	02	02	02
21	DIMM Attributes	26	26	26
22	Component Attributes	C1	C1	C1
23	t <sub>CK</sub> @ CL <sub>max</sub> -0.5 (Byte 18) [ns]	60	60	60



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300HBR-5-C	HYS72D64300HBR-5-C	HYS72D64320HBR-5-C
Organization		256MB	512MB	512MB
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)
Label Code		PC3200R-30331	PC3200R-30331	PC3200R-30331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX
24	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -0.5 [ns]	50	50	50
25	t <sub>CK</sub> @ CL <sub>max</sub> -1 (Byte 18) [ns]	75	75	75
26	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -1 [ns]	50	50	50
27	t <sub>RPmin</sub> [ns]	3C	3C	3C
28	t <sub>RRDmin</sub> [ns]	28	28	28
29	t <sub>RCDmin</sub> [ns]	3C	3C	3C
30	t <sub>RASmin</sub> [ns]	28	28	28
31	Module Density per Rank	40	80	40
32	t <sub>AS</sub> , t <sub>CS</sub> [ns]	60	60	60
33	t <sub>AH</sub> , t <sub>CH</sub> [ns]	60	60	60
34	t <sub>DS</sub> [ns]	40	40	40
35	t <sub>DH</sub> [ns]	40	40	40
36 - 40	Not used	00	00	00
41	t <sub>RCmin</sub> [ns]	37	37	37
42	t <sub>RFCmin</sub> [ns]	41	41	41
43	t <sub>CKmax</sub> [ns]	28	28	28
44	t <sub>DQSQmax</sub> [ns]	28	28	28
45	t <sub>QHSmax</sub> [ns]	50	50	50
46	not used	00	00	00
47	DIMM PCB Height	01	01	01
48 - 61	Not used	00	00	00
62	SPD Revision	10	10	10
63	Checksum of Byte 0-62	26	5F	27
64	Manufacturer's JEDEC ID Code (1)	7F	7F	7F
65	Manufacturer's JEDEC ID Code (2)	7F	7F	7F
66	Manufacturer's JEDEC ID Code (3)	7F	7F	7F
67	Manufacturer's JEDEC ID Code (4)	7F	7F	7F



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300HBR-5-C	HYS72D64300HBR-5-C	HYS72D64320HBR-5-C
Organization		256MB	512MB	512MB
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)
Label Code		PC3200R-30331	PC3200R-30331	PC3200R-30331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX
68	Manufacturer's JEDEC ID Code (5)	7F	7F	7F
69	Manufacturer's JEDEC ID Code (6)	51	51	51
70	Manufacturer's JEDEC ID Code (7)	00	00	00
71	Manufacturer's JEDEC ID Code (8)	00	00	00
72	Module Manufacturer Location	xx	xx	xx
73	Part Number, Char 1	37	37	37
74	Part Number, Char 2	32	32	32
75	Part Number, Char 3	44	44	44
76	Part Number, Char 4	33	36	36
77	Part Number, Char 5	32	34	34
78	Part Number, Char 6	33	33	33
79	Part Number, Char 7	30	30	32
80	Part Number, Char 8	30	30	30
81	Part Number, Char 9	48	48	48
82	Part Number, Char 10	42	42	42
83	Part Number, Char 11	52	52	52
84	Part Number, Char 12	35	35	35
85	Part Number, Char 13	43	43	43
86	Part Number, Char 14	20	20	20
87	Part Number, Char 15	20	20	20
88	Part Number, Char 16	20	20	20
89	Part Number, Char 17	20	20	20
90	Part Number, Char 18	20	20	20
91	Module Revision Code	1x	1x	1x
92	Test Program Revision Code	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

<b>Product Type</b>		<b>HYS72D32300HBR-5-C</b>	<b>HYS72D64300HBR-5-C</b>	<b>HYS72D64320HBR-5-C</b>
<b>Organization</b>		<b>256MB</b>	<b>512MB</b>	<b>512MB</b>
		<b>×72</b>	<b>×72</b>	<b>×72</b>
		<b>1 Rank (×8)</b>	<b>1 Rank (×4)</b>	<b>2 Ranks (×8)</b>
<b>Label Code</b>		<b>PC3200R-30331</b>	<b>PC3200R-30331</b>	<b>PC3200R-30331</b>
<b>JEDEC SPD Revision</b>		<b>Rev. 1.0</b>	<b>Rev. 1.0</b>	<b>Rev. 1.0</b>
<b>Byte#</b>	<b>Description</b>	<b>HEX</b>	<b>HEX</b>	<b>HEX</b>
95 - 98	Module Serial Number	xx	xx	xx
99 - 127	Not used	00	00	00



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

**TABLE 20**  
**HYS72D[32/64/128]3x0HBR-6-C**

Product Type		HYS72D32300HBR-6-C	HYS72D64300HBR-6-C	HYS72D64320HBR-6-C	HYS72D128320HBR-6-C
Organization		256MB	512MB	512MB	1 GByte
		×72	×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)	2 Ranks (×4)
Label Code		PC2700R-25330	PC2700R-25330	PC2700R-25330	PC2700R-25330
JEDEC SPD Revision		Rev. 0.0	Rev. 0.0	Rev. 0.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX	HEX
0	Programmed SPD Bytes in E2PROM	80	80	80	80
1	Total number of Bytes in E2PROM	08	08	08	08
2	Memory Type (DDR = 07h)	07	07	07	07
3	Number of Row Addresses	0D	0D	0D	0D
4	Number of Column Addresses	0A	0B	0A	0B
5	Number of DIMM Ranks	01	01	02	02
6	Data Width (LSB)	48	48	48	48
7	Data Width (MSB)	00	00	00	00
8	Interface Voltage Levels	04	04	04	04
9	t <sub>CK</sub> @ CL <sub>max</sub> (Byte 18) [ns]	60	60	60	60
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (Byte 18) [ns]	70	70	70	70
11	Error Correction Support	02	02	02	02
12	Refresh Rate	82	82	82	82
13	Primary SDRAM Width	08	04	08	04
14	Error Checking SDRAM Width	08	04	08	04
15	t <sub>CCD</sub> [cycles]	01	01	01	01
16	Burst Length Supported	0E	0E	0E	0E
17	Number of Banks on SDRAM Device	04	04	04	04
18	CAS Latency	0C	0C	0C	0C
19	CS Latency	01	01	01	01
20	Write Latency	02	02	02	02
21	DIMM Attributes	26	26	26	26
22	Component Attributes	C1	C1	C1	C1



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300HBR-6-C	HYS72D64300HBR-6-C	HYS72D64320HBR-6-C	HYS72D128320HBR-6-C
Organization		256MB	512MB	512MB	1 GByte
		×72	×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×8)	2 Ranks (×4)
Label Code		PC2700R-25330	PC2700R-25330	PC2700R-25330	PC2700R-25330
JEDEC SPD Revision		Rev. 0.0	Rev. 0.0	Rev. 0.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX	HEX
23	t <sub>CK</sub> @ CL <sub>max</sub> -0.5 (Byte 18) [ns]	75	75	75	75
24	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -0.5 [ns]	70	70	70	70
25	t <sub>CK</sub> @ CL <sub>max</sub> -1 (Byte 18) [ns]	00	00	00	00
26	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -1 [ns]	00	00	00	00
27	t <sub>RPmin</sub> [ns]	48	48	48	48
28	t <sub>RRDmin</sub> [ns]	30	30	30	30
29	t <sub>RCDmin</sub> [ns]	48	48	48	48
30	t <sub>RASmin</sub> [ns]	2A	2A	2A	2A
31	Module Density per Rank	40	80	40	80
32	t <sub>AS</sub> , t <sub>CS</sub> [ns]	75	75	75	75
33	t <sub>AH</sub> , t <sub>CH</sub> [ns]	75	75	75	75
34	t <sub>DS</sub> [ns]	45	45	45	45
35	t <sub>DH</sub> [ns]	45	45	45	45
36 - 40	Not used	00	00	00	00
41	t <sub>RCmin</sub> [ns]	3C	3C	3C	3C
42	t <sub>RFCmin</sub> [ns]	48	48	48	48
43	t <sub>CKmax</sub> [ns]	30	30	30	30
44	t <sub>DQSQmax</sub> [ns]	28	28	28	28
45	t <sub>QHSmax</sub> [ns]	50	50	50	50
46	not used	00	00	00	00
47	DIMM PCB Height	00	00	00	00
48 - 61	Not used	00	00	00	00
62	SPD Revision	00	00	00	00
63	Checksum of Byte 0-62	0F	48	10	49
64	Manufacturer's JEDEC ID Code (1)	7F	7F	7F	7F
65	Manufacturer's JEDEC ID Code (2)	7F	7F	7F	7F



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

<b>Product Type</b>		<b>HYS72D32300HBR-6-C</b>	<b>HYS72D64300HBR-6-C</b>	<b>HYS72D64320HBR-6-C</b>	<b>HYS72D128320HBR-6-C</b>
<b>Organization</b>		<b>256MB</b>	<b>512MB</b>	<b>512MB</b>	<b>1 GByte</b>
		<b>×72</b>	<b>×72</b>	<b>×72</b>	<b>×72</b>
		<b>1 Rank (×8)</b>	<b>1 Rank (×4)</b>	<b>2 Ranks (×8)</b>	<b>2 Ranks (×4)</b>
<b>Label Code</b>		<b>PC2700R-25330</b>	<b>PC2700R-25330</b>	<b>PC2700R-25330</b>	<b>PC2700R-25330</b>
<b>JEDEC SPD Revision</b>		<b>Rev. 0.0</b>	<b>Rev. 0.0</b>	<b>Rev. 0.0</b>	<b>Rev. 0.0</b>
<b>Byte#</b>	<b>Description</b>	<b>HEX</b>	<b>HEX</b>	<b>HEX</b>	<b>HEX</b>
66	Manufacturer's JEDEC ID Code (3)	7F	7F	7F	7F
67	Manufacturer's JEDEC ID Code (4)	7F	7F	7F	7F
68	Manufacturer's JEDEC ID Code (5)	7F	7F	7F	7F
69	Manufacturer's JEDEC ID Code (6)	51	51	51	51
70	Manufacturer's JEDEC ID Code (7)	00	00	00	00
71	Manufacturer's JEDEC ID Code (8)	00	00	00	00
72	Module Manufacturer Location	xx	xx	xx	xx
73	Part Number, Char 1	37	37	37	37
74	Part Number, Char 2	32	32	32	32
75	Part Number, Char 3	44	44	44	44
76	Part Number, Char 4	33	36	36	31
77	Part Number, Char 5	32	34	34	32
78	Part Number, Char 6	33	33	33	38
79	Part Number, Char 7	30	30	32	33
80	Part Number, Char 8	30	30	30	32
81	Part Number, Char 9	48	48	48	30
82	Part Number, Char 10	42	42	42	48
83	Part Number, Char 11	52	52	52	42
84	Part Number, Char 12	36	36	36	52
85	Part Number, Char 13	43	43	43	36
86	Part Number, Char 14	20	20	20	43
87	Part Number, Char 15	20	20	20	20
88	Part Number, Char 16	20	20	20	20
89	Part Number, Char 17	20	20	20	20
90	Part Number, Char 18	20	20	20	20
91	Module Revision Code	1x	1x	1x	1x



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

<b>Product Type</b>		<b>HYS72D32300HBR-6-C</b>	<b>HYS72D64300HBR-6-C</b>	<b>HYS72D64320HBR-6-C</b>	<b>HYS72D128320HBR-6-C</b>
<b>Organization</b>		<b>256MB</b>	<b>512MB</b>	<b>512MB</b>	<b>1 GByte</b>
		<b>×72</b>	<b>×72</b>	<b>×72</b>	<b>×72</b>
		<b>1 Rank (×8)</b>	<b>1 Rank (×4)</b>	<b>2 Ranks (×8)</b>	<b>2 Ranks (×4)</b>
<b>Label Code</b>		<b>PC2700R-25330</b>	<b>PC2700R-25330</b>	<b>PC2700R-25330</b>	<b>PC2700R-25330</b>
<b>JEDEC SPD Revision</b>		<b>Rev. 0.0</b>	<b>Rev. 0.0</b>	<b>Rev. 0.0</b>	<b>Rev. 0.0</b>
<b>Byte#</b>	<b>Description</b>	<b>HEX</b>	<b>HEX</b>	<b>HEX</b>	<b>HEX</b>
92	Test Program Revision Code	xx	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx	xx
99 - 127	Not used	00	00	00	00





HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

**TABLE 21**  
**HYS72D[32/64/128]3x0HBR-7-C**

Product Type		HYS72D32300HBR-7-C	HYS72D64300HBR-7-C	HYS72D128320HBR-7-C
Organization		256MB	512MB	1 GByte
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×4)
Label Code		PC2100R-20330	PC2100R-20331	PC2100R-20330
JEDEC SPD Revision		Rev. 0.0	Rev. 1.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX
0	Programmed SPD Bytes in E2PROM	80	80	80
1	Total number of Bytes in E2PROM	08	08	08
2	Memory Type (DDR = 07h)	07	07	07
3	Number of Row Addresses	0D	0D	0D
4	Number of Column Addresses	0A	0B	0B
5	Number of DIMM Ranks	01	01	02
6	Data Width (LSB)	48	48	48
7	Data Width (MSB)	00	00	00
8	Interface Voltage Levels	04	04	04
9	t <sub>CK</sub> @ CL <sub>max</sub> (Byte 18) [ns]	70	70	70
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (Byte 18) [ns]	75	75	75
11	Error Correction Support	02	02	02
12	Refresh Rate	82	82	82
13	Primary SDRAM Width	08	04	04
14	Error Checking SDRAM Width	08	04	04
15	t <sub>CCD</sub> [cycles]	01	01	01
16	Burst Length Supported	0E	0E	0E
17	Number of Banks on SDRAM Device	04	04	04
18	CAS Latency	0C	0C	0C
19	CS Latency	01	01	01
20	Write Latency	02	02	02
21	DIMM Attributes	26	26	26
22	Component Attributes	C1	C1	C1
23	t <sub>CK</sub> @ CL <sub>max</sub> -0.5 (Byte 18) [ns]	75	75	75



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300HBR-7-C	HYS72D64300HBR-7-C	HYS72D128320HBR-7-C
Organization		256MB	512MB	1 GByte
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×4)
Label Code		PC2100R-20330	PC2100R-20331	PC2100R-20330
JEDEC SPD Revision		Rev. 0.0	Rev. 1.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX
24	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -0.5 [ns]	75	75	75
25	t <sub>CK</sub> @ CL <sub>max</sub> -1 (Byte 18) [ns]	00	00	00
26	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -1 [ns]	00	00	00
27	t <sub>RPmin</sub> [ns]	50	50	50
28	t <sub>RRDmin</sub> [ns]	3C	3C	3C
29	t <sub>RCDmin</sub> [ns]	50	50	50
30	t <sub>RASmin</sub> [ns]	2D	2D	2D
31	Module Density per Rank	40	80	80
32	t <sub>AS</sub> , t <sub>CS</sub> [ns]	90	90	90
33	t <sub>AH</sub> , t <sub>CH</sub> [ns]	90	90	90
34	t <sub>DS</sub> [ns]	50	50	50
35	t <sub>DH</sub> [ns]	50	50	50
36 - 40	Not used	00	00	00
41	t <sub>RCmin</sub> [ns]	41	41	41
42	t <sub>RFCmin</sub> [ns]	4B	4B	4B
43	t <sub>CKmax</sub> [ns]	30	30	30
44	t <sub>DQSQmax</sub> [ns]	32	32	32
45	t <sub>QHSmax</sub> [ns]	75	75	75
46	not used	00	00	00
47	DIMM PCB Height	00	00	00
48 - 61	Not used	00	00	00
62	SPD Revision	00	10	00
63	Checksum of Byte 0-62	CB	14	05
64	Manufacturer's JEDEC ID Code (1)	7F	7F	7F
65	Manufacturer's JEDEC ID Code (2)	7F	7F	7F
66	Manufacturer's JEDEC ID Code (3)	7F	7F	7F



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

Product Type		HYS72D32300HBR-7-C	HYS72D64300HBR-7-C	HYS72D128320HBR-7-C
Organization		256MB	512MB	1 GByte
		×72	×72	×72
		1 Rank (×8)	1 Rank (×4)	2 Ranks (×4)
Label Code		PC2100R-20330	PC2100R-20331	PC2100R-20330
JEDEC SPD Revision		Rev. 0.0	Rev. 1.0	Rev. 0.0
Byte#	Description	HEX	HEX	HEX
67	Manufacturer's JEDEC ID Code (4)	7F	7F	7F
68	Manufacturer's JEDEC ID Code (5)	7F	7F	7F
69	Manufacturer's JEDEC ID Code (6)	51	51	51
70	Manufacturer's JEDEC ID Code (7)	00	00	00
71	Manufacturer's JEDEC ID Code (8)	00	00	00
72	Module Manufacturer Location	xx	xx	xx
73	Part Number, Char 1	37	37	37
74	Part Number, Char 2	32	32	32
75	Part Number, Char 3	44	44	44
76	Part Number, Char 4	33	36	31
77	Part Number, Char 5	32	34	32
78	Part Number, Char 6	33	33	38
79	Part Number, Char 7	30	30	33
80	Part Number, Char 8	30	30	32
81	Part Number, Char 9	48	48	30
82	Part Number, Char 10	42	42	48
83	Part Number, Char 11	52	52	42
84	Part Number, Char 12	37	37	52
85	Part Number, Char 13	43	43	37
86	Part Number, Char 14	20	20	43
87	Part Number, Char 15	20	20	20
88	Part Number, Char 16	20	20	20
89	Part Number, Char 17	20	20	20
90	Part Number, Char 18	20	20	20
91	Module Revision Code	1x	0x	1x
92	Test Program Revision Code	xx	xx	xx



HYS72D[128/64/32]3xx[G/H]BR-[5/6/7]-C  
Registered Double Data Rate SDRAM

<b>Product Type</b>		<b>HYS72D32300HBR-7-C</b>	<b>HYS72D64300HBR-7-C</b>	<b>HYS72D128320HBR-7-C</b>
<b>Organization</b>		<b>256MB</b>	<b>512MB</b>	<b>1 GByte</b>
		<b>×72</b>	<b>×72</b>	<b>×72</b>
		<b>1 Rank (×8)</b>	<b>1 Rank (×4)</b>	<b>2 Ranks (×4)</b>
<b>Label Code</b>		<b>PC2100R-20330</b>	<b>PC2100R-20331</b>	<b>PC2100R-20330</b>
<b>JEDEC SPD Revision</b>		<b>Rev. 0.0</b>	<b>Rev. 1.0</b>	<b>Rev. 0.0</b>
<b>Byte#</b>	<b>Description</b>	<b>HEX</b>	<b>HEX</b>	<b>HEX</b>
93	Module Manufacturing Date Year	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx
99 - 127	Not used	00	00	00



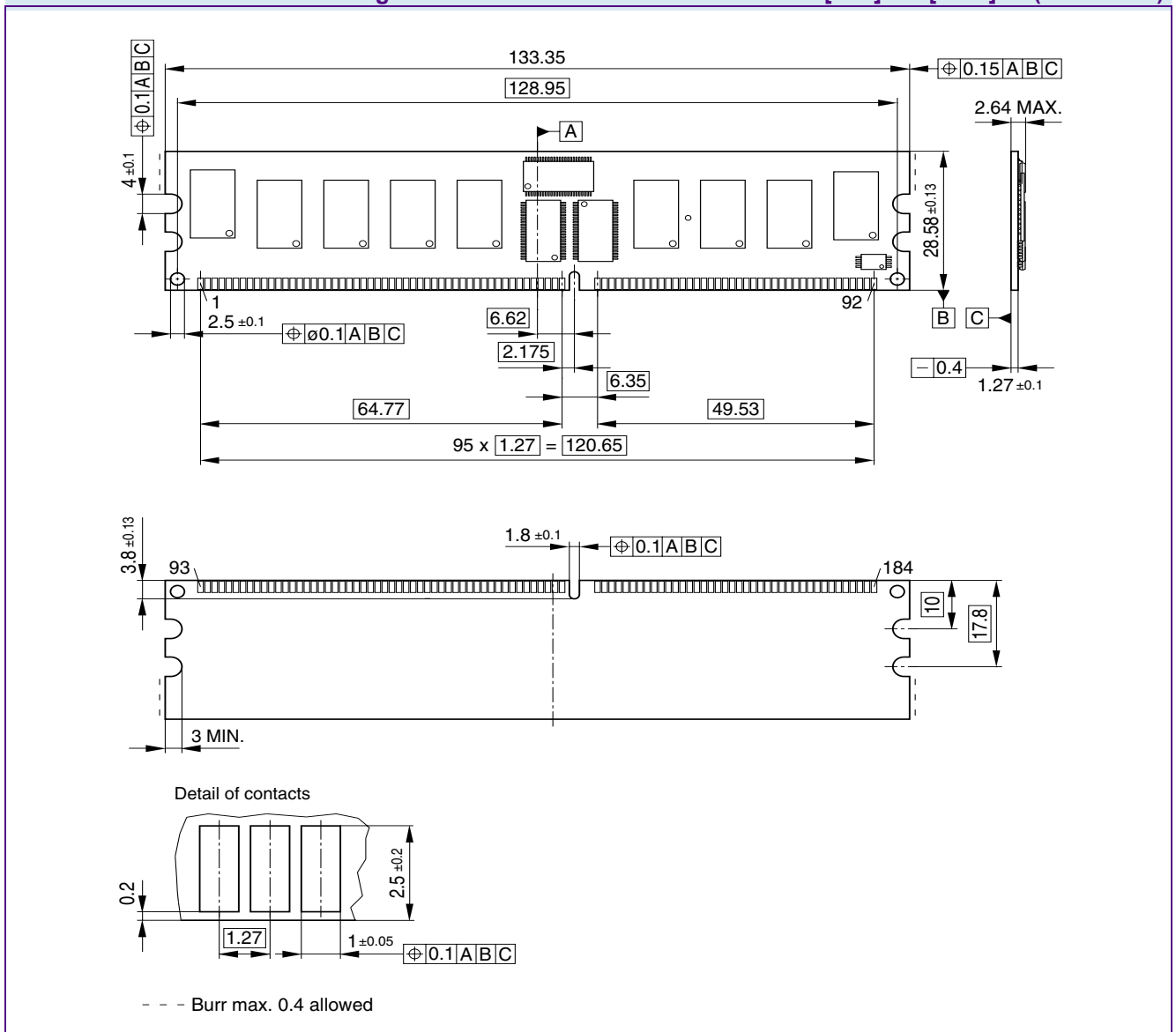
# 5 Package Outlines

This chapter contains the package outlines of the products.

## 5.1 Raw Card A

**FIGURE 2**

**Package Outlines – Raw Card A HYS72D32300[G/H]BR-[5/6/7]-C (1 Rank × 8)**

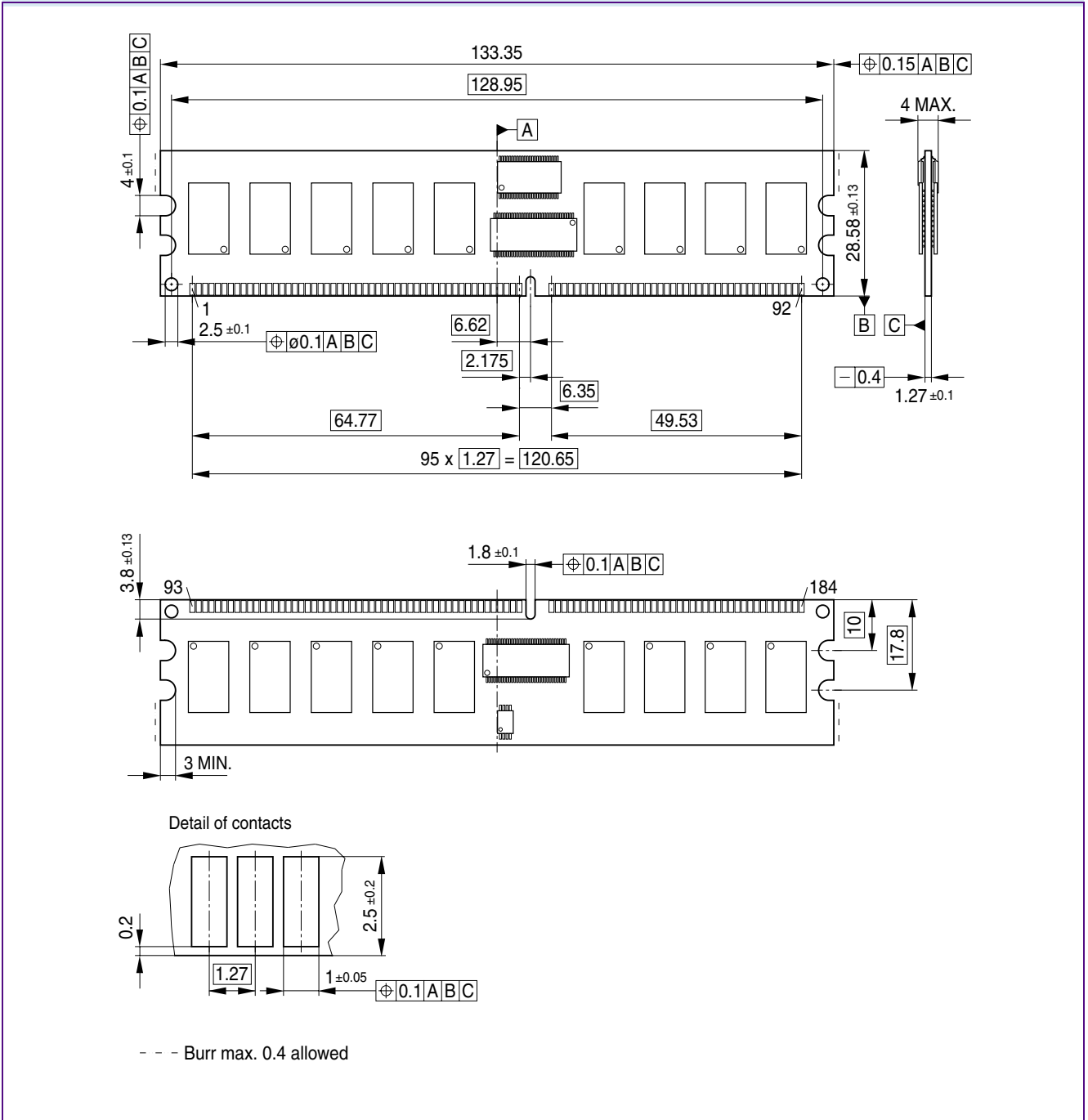




## 5.2 Raw Card B

**FIGURE 3**

**Package Outlines – Raw Card B HYS72D64320GBR-[5/6]-C (2 Ranks x8)**

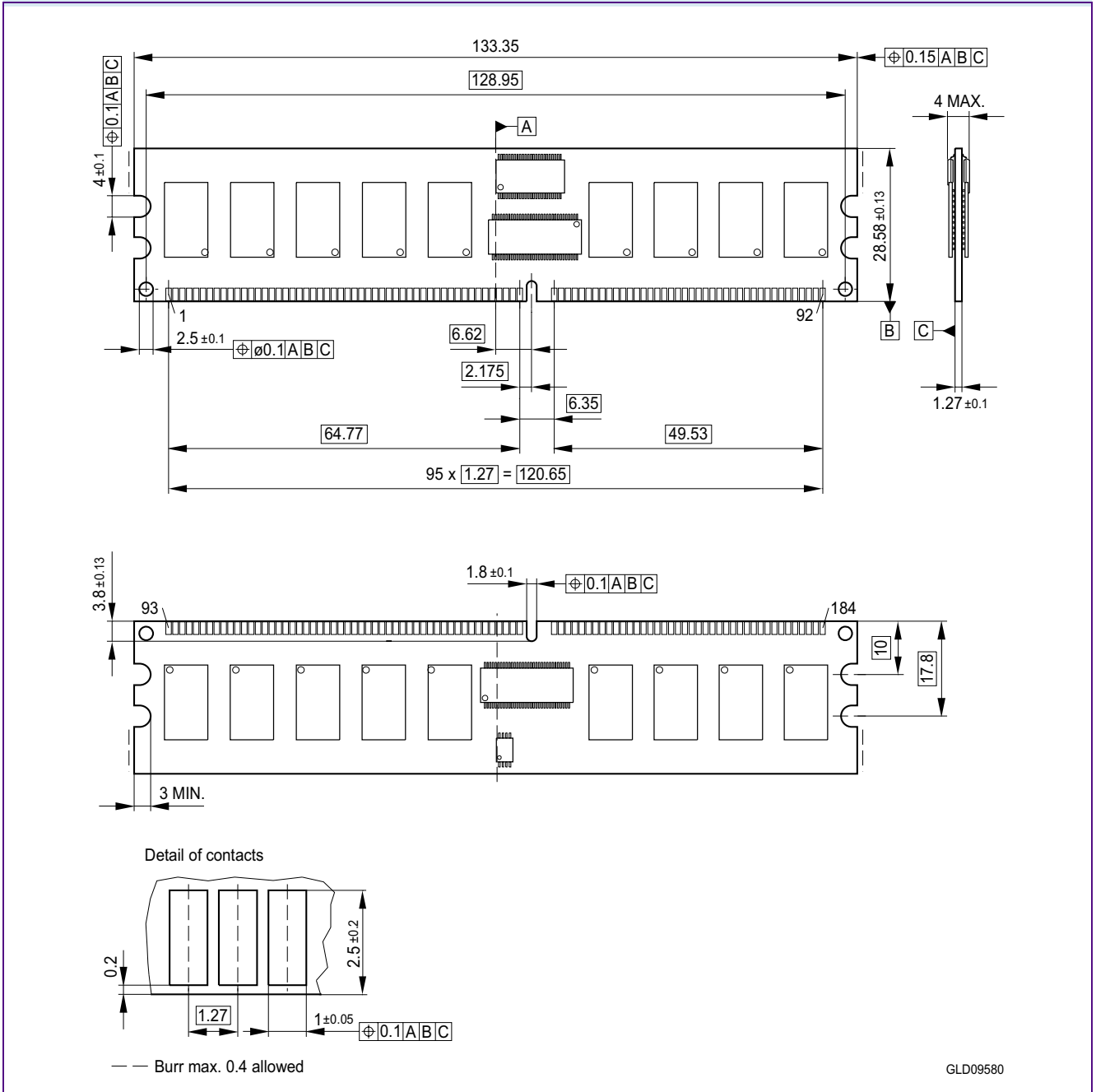




### 5.3 Raw Card C

**FIGURE 4**

**Package Outlines – Raw Card C HYS72D64300[G/H]BR-[5/6/7]-C (1 Rank × 4)**









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