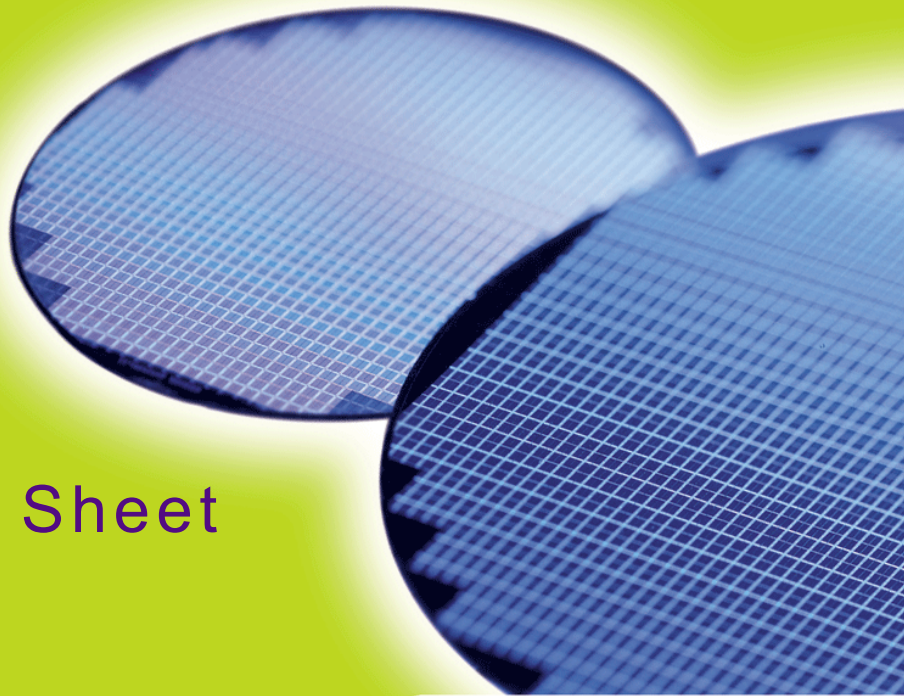


HYS64D32301HU-[5/6]-C  
HYS[72/64]D64300HU-[5/6]-C  
HYS[64/72]D128320HU-[5/6]-C

*184-Pin Unbuffered Double Data Rate SDRAM  
UDIMM  
DDR SDRAM  
RoHS Compliant Products*



Internet Data Sheet

*Rev. 1.21*

HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

<b>HYS64D32301HU-[5/6]-C, HYS[72/64]D64300HU-[5/6]-C, HYS[64/72]D128320HU-[5/6]-C</b>	
<b>Revision History: 2006-09, Rev. 1.21</b>	
<b>Page</b>	<b>Subjects (major changes since last revision)</b>
All	Adapted internet edition
<b>Previous Revision: Rev. 1.20, 2005-12</b>	
<b>14</b>	changed component configuration for 256MB to 32M x16
<b>26</b>	changed DDR400 $t_{RFC}$ from 70 ns to 65 ns
<b>Previous Revision: Rev. 1.10, 2005-05</b>	

**We Listen to Your Comments**

Any information within this document that you feel is wrong, unclear or missing at all?

Your feedback will help us to continuously improve the quality of this document.

Please send your proposal (including a reference to this document) to:

[techdoc@qimonda.com](mailto:techdoc@qimonda.com)



# 1 Overview

This chapter gives an overview of the 184-Pin Unbuffered Double Data Rate SDRAM product family and describes its main characteristics.

## 1.1 Features

- 184-Pin Unbuffered Double Data Rate SDRAM (ECC and non-parity) for PC and Workstation main memory applications
- One rank 32M ×64, 64M ×64, 64M ×72, and two ranks 128M ×64, 128M ×72 organization
- Standard Double Data Rate Synchronous DRAMs (DDR SDRAM) Single +2.5V (±0.2V) and +2.6V (±0.1V) power supply for DDR400
- Built with 512 Mbit DDR SDRAM in P-TSOP11-66-1 package
- 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 E<sup>2</sup>PROM
- Standard MO-206 form factor: 133.35 mm × 31.75 mm × 4.00 mm max.
- Standard reference layout for raw cards: A, B and C
- Gold plated contacts
- RoHS Compliant Product<sup>1)</sup>

**TABLE 1**  
Performance

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

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.

HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

## 1.2 Description

The HYS64D32301HU-[5/6]-C, HYS[72/64]D64300HU-[5/6]-C, HYS[64/72]D128320HU-[5/6]-C, and are industry standard 184-Pin Unbuffered Double Data Rate SDRAM (UDIMM) organized as 32M × 64 (256 MB), 64M × 64 (512 MB), 128M × 64 (1 GB) for non-parity and 64M × 72 (512 MB), 128M × 72 (1 GB) for ECC main memory applications. The memory array is

designed with 512Mbit Double Data Rate Synchronous DRAMs. A variety of decoupling capacitors are mounted on the printed circuit board. The DIMMs feature serial presence detect (SPD) 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



**TABLE 2**  
Ordering Information for Lead-Free Products (RoHSCompliant Product)

Product Type <sup>1)</sup>	Compliance Code <sup>2)</sup>	Description	SDRAM Technology
<b>PC3200 (CL=3.0)</b>			
HYS64D32301HU-5-C	PC3200U-30331-C3	one rank 256 MB DIMM	512 Mbit (×16)
HYS64D64300HU-5-C	PC3200U-30331-A1	one rank 512 MB DIMM	512 Mbit (×8)
HYS72D64300HU-5-C	PC3200U-30331-A1	one rank 512 MB ECC-DIMM	512 Mbit (×8)
HYS64D128320HU-5-C	PC3200U-30331-B2	two ranks 1 GB DIMM	512 Mbit (×8)
HYS72D128320HU-5-C	PC3200U-30331-B2	two ranks 1 GB ECC-DIMM	512 Mbit (×8)
<b>PC2700 (CL=2.5)</b>			
HYS64D32301HU-6-C	PC2700U-25331-C3	one rank 256 MB DIMM	512 Mbit (×16)
HYS64D64300HU-6-C	PC2700U-25331-A1	one rank 512 MB DIMM	512 Mbit (×8)
HYS72D64300HU-6-C	PC2700U-25331-A1	one rank 512 MB ECC-DIMM	512 Mbit (×8)
HYS64D128320HU-6-C	PC2700U-25331-B2	two ranks 1 GB DIMM	512 Mbit (×8)
HYS72D128320HU-6-C	PC2700U-25331-B2	two ranks 1 GB ECC-DIMM	512 Mbit (×8)

1) All product types end with a place code designating the silicon-die revision. Reference information available on request. Example: HYS64D128320HU-5-C, indicating Rev.C die are used for SDRAM components.

2) The Compliance Code is printed on the module labels and describes the speed sort (for example "PC3200"), the latencies (for example "30330" means CAS latency of 3.0 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.



## 2 Pin Configuration

The pin configuration of the Unbuffered DDR SDRAM DIMM is listed by function in **Table 3** (184 pins). The abbreviations used in columns Pin and Buffer Type are explained in **Table 4** and **Table 5** respectively. The pin numbering is depicted in **Figure 1**.

**TABLE 3**  
Pin Configuration of UDIMM

Pin#	Name	Pin Type	Buffer Type	Function
<b>Clock Signals</b>				
137	CK0	I	SSTL	<b>Clock Signals 2:0</b>
	NC	NC	–	
16	CK1	I	SSTL	
76	CK2	I	SSTL	
138	$\overline{\text{CK0}}$	I	SSTL	<b>Complement Clock Signals 2:0</b>
	NC	NC	–	
17	$\overline{\text{CK1}}$	I	SSTL	
75	$\overline{\text{CK2}}$	I	SSTL	
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	–	<i>Note: 1-rank module</i>
<b>Control Signals</b>				
157	$\overline{\text{S0}}$	I	SSTL	<b>Chip Select Rank 0</b>
158	$\overline{\text{S1}}$	I	SSTL	<b>Chip Select Rank 1</b> <i>Note: 2-rank 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>
<b>Address Signals</b>				
59	BA0	I	SSTL	<b>Bank Address Bus 2:0</b>
52	BA1	I	SSTL	



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Pin#	Name	Pin Type	Buffer Type	Function
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	
125	A6	I	SSTL	
29	A7	I	SSTL	
122	A8	I	SSTL	<b>Address Bus 11:0</b>
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	-

HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Pin#	Name	Pin Type	Buffer Type	Function
<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	
105	DQ12	I/O	SSTL	
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	

HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Pin#	Name	Pin Type	Buffer Type	Function
121	DQ22	I/O	SSTL	Data Bus 63:0
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	
165	DQ52	I/O	SSTL	
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	





HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Pin#	Name	Pin Type	Buffer Type	Function
178	DQ62	I/O	SSTL	<b>Data Bus 63:0</b>
179	DQ63	I/O	SSTL	
44	CB0	I/O	SSTL	<b>Check Bit 0</b>
	NC	NC	–	
45	CB1	I/O	SSTL	<b>Check Bit 1</b>
	NC	NC	–	
49	CB2	I/O	SSTL	<b>Check Bit 2</b>
	NC	NC	–	
51	CB3	I/O	SSTL	<b>Check Bit 3</b>
	NC	NC	–	
134	CB4	I/O	SSTL	<b>Check Bit 4</b>
	NC	NC	–	
135	CB5	I/O	SSTL	<b>Check Bit 5</b>
	NC	NC	–	
142	CB6	I/O	SSTL	<b>Check Bit 6</b>
	NC	NC	–	
144	CB7	I/O	SSTL	<b>Check Bit 7</b>
	NC	NC	–	
5	DQS0	I/O	SSTL	<b>Data Strobe Bus 7:0</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	
78	DQS6	I/O	SSTL	
86	DQS7	I/O	SSTL	
47	DQS8	I/O	SSTL	<b>Data Strobe 8</b>
	NC	NC	–	
97	DM0	I	SSTL	<b>Data Mask Bus 7:0</b>
107	DM1	I	SSTL	
119	DM2	I	SSTL	
129	DM3	I	SSTL	
149	DM4	I	SSTL	
159	DM5	I	SSTL	
169	DM6	I	SSTL	
177	DM7	I	SSTL	
140	DM8	I	SSTL	<b>Data Mask 8</b>
	NC	NC	–	
<b>EEPROM</b>				
92	SCL	I	CMOS	<b>Serial Bus Clock</b>



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Pin#	Name	Pin Type	Buffer Type	Function
91	SDA	I/O	OD	<b>Serial Bus Data</b>
181	SA0	I	CMOS	Slave Address Select Bus 2:0
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>EEPROM Power Supply</b>
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>

HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Pin#	Name	Pin Type	Buffer Type	Function
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>
<b>Other Pins</b>				
82	V <sub>DDID</sub>	O	OD	<b>V<sub>DD</sub> Identification</b>
9, 10, 71, 90, 101, 102, 103, 113, 163, 173	NC	NC	–	<b>Not connected</b>

HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules**TABLE 4**  
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

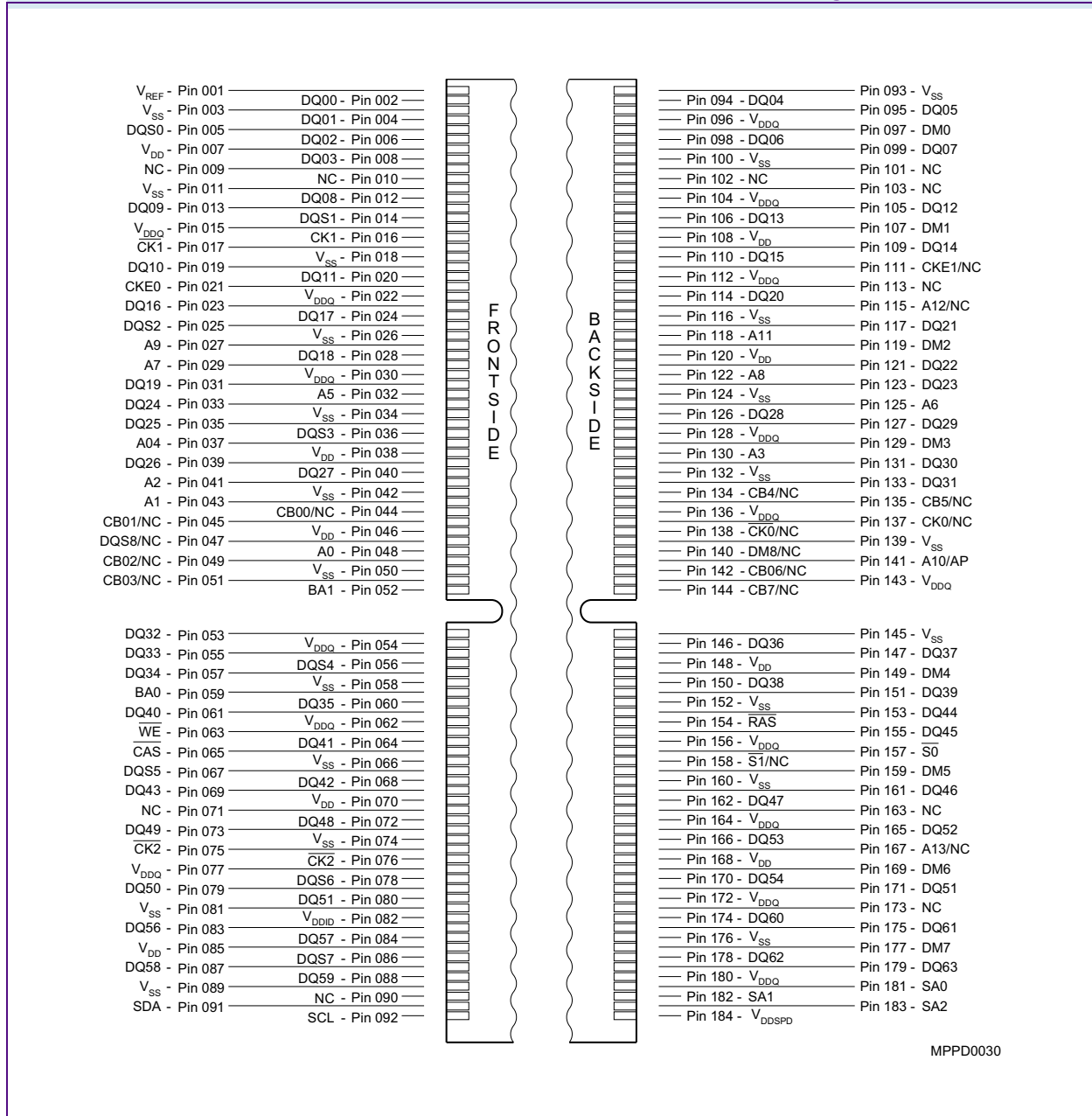
**TABLE 5**  
Abbreviations for Buffer Type

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.



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

**FIGURE 1**  
**Pin Configuration 184-Pin, UDIMM**



MPPD0030

**Notes**

1.  $V_{DD} = V_{DDQ}$ , therefore  $V_{DDID}$  strap open

2.  $DQ$ ,  $DQS$ ,  $DM$  resistors are  $22 \Omega \pm 5\%$

3.  $BAn$ ,  $An$ ,  $RAS$ ,  $CAS$ ,  $WE$  resistors are  $3 \Omega \pm 5\%$

HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules**TABLE 6**  
Address Format

Density	Organization	Memory Ranks	SDRAMs	# of SDRAMs	# of row/bank/ columns bits	Refresh	Period	Interval
256 MB	32M ×64	1	32M ×16	4	13/2/10	8K	64 ms	7.8 ms
512 MB	64M ×64	1	64M ×8	8	13/2/11	8K	64 ms	7.8 ms
512 MB	64M ×72	1	64M ×8	9	13/2/11	8K	64 ms	7.8 ms
1 GB	128M ×64	2	64M ×8	16	13/2/11	8K	64 ms	7.8 ms
1 GB	128M ×72	2	64M ×8	18	13/2/11	8K	64 ms	7.8 ms



## 3 Electrical Characteristics

### 3.1 Operating Conditions

**TABLE 12**  
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 13**  
Electrical Characteristics and DC Operating Conditions

Parameter	Symbol	Values			Unit	Note/Test Condition <sup>1)</sup>
		Min.	Typ.	Max.		
Device Supply Voltage	$V_{DD}$	2.3	2.5	2.7	V	fck ≤ 166 MHz
Device Supply Voltage	$V_{DD}$	2.5	2.6	2.7	V	fck ≤ 166 MHz <sup>2)</sup>
Output Supply Voltage	$V_{DDQ}$	2.3	2.5	2.7	V	fck ≤ 166 MHz <sup>3)</sup>
Output Supply Voltage	$V_{DDQ}$	2.5	2.6	2.7	V	fck ≤ 166 MHz <sup>2)3)</sup>
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	$V_{REF}$	$0.49 \times V_{DDQ}$	$0.5 \times V_{DDQ}$	$0.51 \times V_{DDQ}$	V	<sup>4)</sup>
I/O Termination Voltage (System)	$V_{TT}$	$V_{REF} - 0.04$		$V_{REF} + 0.04$	V	<sup>5)</sup>



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

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

- 1)  $0\text{ }^\circ\text{C} \leq T_A \leq 70\text{ }^\circ\text{C}$ ;  $V_{DDQ} = 2.5\text{ V} \pm 0.2\text{ V}$ ,  $V_{DD} = +2.5\text{ V} \pm 0.2\text{ V}$ ;  $V_{DDQ} = 2.6\text{ V} \pm 0.1\text{ V}$ ,  $V_{DD} = +2.6\text{ V} \pm 0.1\text{ V}$  (DDR400);
- 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  $\overline{\text{CK}}$ .
- 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 pin.





### 3.2 $I_{DD}$ Specification and Conditions

**TABLE 14**  
 **$I_{DD}$  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> $\overline{CS} \geq V_{IH,MIN}$ , 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> $\overline{CS} \geq V_{IH,MIN}$ , 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; $\overline{CS} \geq V_{IH,MIN}$ ; $CKE \geq V_{IH,MIN}$ ; $t_{RC} = t_{RAS,MAX}$ ; 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.	$I_{DD7}$



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

**TABLE 15**  
 **$I_{DD}$  Specification for HYS[64/72]D[32/64/128]3xxHU-5-C**

Product Type	HYS64D32301HU-5-C		HYS64D64300HU-5-C		HYS72D64300HU-5-C		HYS64D128320HU-5-C		HYS72D128320HU-5-C		Unit	Note <sup>1)2)</sup>
Organization	256MB		512MB		512MB		1GB		1GB			
	×64		×64		×72		×64		×72			
	1 Rank		1 Rank		1 Rank		2 Ranks		2 Ranks			
	-5		-5		-5		-5		-5			
Symbol	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.		
$I_{DD0}$	300	360	480	600	540	680	760	940	860	1050	mA	3)
$I_{DD1}$	360	440	560	680	630	770	840	1020	950	1140	mA	3)4)
$I_{DD2P}$	4	18	9	37	10	41	18	74	20	83	mA	5)
$I_{DD2F}$	100	120	200	240	230	270	400	480	450	540	mA	5)
$I_{DD2Q}$	70	90	140	180	150	210	270	370	310	410	mA	5)
$I_{DD3P}$	50	60	100	130	110	140	190	260	220	290	mA	5)
$I_{DD3N}$	150	180	280	340	320	380	560	670	630	760	mA	5)
$I_{DD4R}$	440	540	640	720	720	810	920	1060	1040	1190	mA	3)4)
$I_{DD4W}$	460	540	680	760	770	860	960	1100	1080	1230	mA	3)
$I_{DD5}$	580	760	1160	1520	1310	1710	1440	1860	620	2090	mA	3)
$I_{DD6}$	6	20	13	40	14	45	26	80	29	90	mA	5)
$I_{DD7}$	840	1000	1560	1840	1760	2070	1840	2180	2070	2450	mA	3)4)

- 1) DRAM component currents only
- 2) Test condition for maximum values:  $V_{DD} = 2.7\text{ V}$ ,  $T_A = 10\text{ °C}$
- 3) The module  $I_{DDx}$  values are calculated from the component  $I_{DDx}$  data sheet values as:  
 $m \times I_{DDx}[\text{component}] + n \times I_{DD3N}[\text{component}]$  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 into calculations: module  $I_{DD}$  values will be measured differently depending on load conditions
- 5) The module  $I_{DDx}$  values are calculated from the component  $I_{DDx}$  data sheet values as:  $(m + n) \times I_{DDx}[\text{component}]$



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

**TABLE 16**  
 **$I_{DD}$  Specification for HYS[64/72]D[32/64/128]3xxHU-6-C**

Product Type	HYS64D32301HU-6-C		HYS64D64300HU-6-C		HYS72D64300HU-6-C		HYS64D128320HU-6-C		HYS72D128320HU-6-C		Unit	Note <sup>1)2)</sup>
Organization	256MB		512MB		512MB		1GB		1GB			
	×64		×64		×72		×64		×72			
	1 Rank		1 Rank		1 Rank		2 Ranks		2 Ranks			
	-6		-6		-6		-6		-6			
Symbol	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.		
$I_{DD0}$	280	340	480	560	540	630	740	860	830	960	mA	<sup>3)</sup>
$I_{DD1}$	320	380	520	640	590	720	780	940	870	1050	mA	<sup>3)4)</sup>
$I_{DD2P}$	4	18	9	37	10	41	18	74	20	83	mA	<sup>5)</sup>
$I_{DD2F}$	80	100	170	200	190	230	340	400	380	450	mA	<sup>5)</sup>
$I_{DD2Q}$	60	90	120	180	140	200	240	350	270	400	mA	<sup>5)</sup>
$I_{DD3P}$	40	60	90	120	100	140	180	240	200	270	mA	<sup>5)</sup>
$I_{DD3N}$	130	160	260	300	290	330	510	590	580	670	mA	<sup>5)</sup>
$I_{DD4R}$	380	460	560	680	630	770	820	980	920	1100	mA	<sup>3)4)</sup>
$I_{DD4W}$	400	480	600	720	680	810	860	1020	960	1140	mA	<sup>3)</sup>
$I_{DD5}$	520	700	1040	1400	1170	1580	1300	1700	1460	1910	mA	<sup>3)</sup>
$I_{DD6}$	6.4	20	12.8	40	14.4	45	25.6	80	28.8	90	mA	<sup>5)</sup>
$I_{DD7}$	760	920	1400	1640	1580	1850	1660	1940	1860	2180	mA	<sup>3)4)</sup>

- 1) DRAM component currents only
- 2) Test condition for maximum values:  $V_{DD} = 2.6 \text{ V}$ ,  $T_A = 10 \text{ °C}$
- 3) The module  $I_{DDx}$  values are calculated from the component  $I_{DDx}$  data sheet values as:  
 $m \times I_{DDx}[\text{component}] + n \times I_{DD3N}[\text{component}]$  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 into calculations: module  $I_{DD}$  values will be measured differently depending on load conditions
- 5) The module  $I_{DDx}$  values are calculated from the component  $I_{DDx}$  data sheet values as:  $(m + n) \times I_{DDx}[\text{component}]$



### 3.3 AC Characteristics

**TABLE 17**  
**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 CK/CK	t <sub>AC</sub>	-0.7	+0.5	-0.7	+0.7	ns	2)3)4)5)
CK high-level width	t <sub>CH</sub>	0.45	0.55	0.45	0.55	t <sub>CK</sub>	2)3)4)5)
Clock cycle time	t <sub>CK</sub>	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 <sub>CL</sub>	0.45	0.55	0.45	0.55	t <sub>CK</sub>	2)3)4)5)
Auto precharge write recovery + precharge time	t <sub>DAL</sub>	(t <sub>WR</sub> /t <sub>CK</sub> ) + (t <sub>RP</sub> /t <sub>CK</sub> )				t <sub>CK</sub>	2)3)4)5)6)
DQ and DM input hold time	t <sub>DH</sub>	0.4	—	0.45	—	ns	2)3)4)5)
DQ and DM input pulse width (each input)	t <sub>DIPW</sub>	1.75	—	1.75	—	ns	2)3)4)5)6)
DQS output access time from CK/CK	t <sub>DQSCK</sub>	-0.5	+0.5	-0.6	+0.6	ns	2)3)4)5)
DQS input low (high) pulse width (write cycle)	t <sub>DQSL,H</sub>	0.35	—	0.35	—	t <sub>CK</sub>	2)3)4)5)
DQS-DQ skew (DQS and associated DQ signals)	t <sub>DQSQ</sub>	—	+0.40	—	+0.45	ns	TSOPII 2)3)4)5)
Write command to 1 <sup>st</sup> DQS latching transition	t <sub>DQSS</sub>	0.72	1.25	0.75	1.25	t <sub>CK</sub>	2)3)4)5)
DQ and DM input setup time	t <sub>DS</sub>	0.4	—	0.45	—	ns	2)3)4)5)
DQS falling edge hold time from CK (write cycle)	t <sub>DSH</sub>	0.2	—	0.2	—	t <sub>CK</sub>	2)3)4)5)
DQS falling edge to CK setup time (write cycle)	t <sub>DSS</sub>	0.2	—	0.2	—	t <sub>CK</sub>	2)3)4)5)
Clock Half Period	t <sub>HP</sub>	min. (t <sub>CL</sub> , t <sub>CH</sub> )	—	min. (t <sub>CL</sub> , t <sub>CH</sub> )	—	ns	2)3)4)5)
Data-out high-impedance time from CK/CK	t <sub>HZ</sub>	—	+0.7	-0.7	+0.7	ns	2)3)4)5)7)
Address and control input hold time	t <sub>IH</sub>	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 <sub>IPW</sub>	2.2	—	2.2	—	ns	2)3)4)5)9)



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

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

- 1) 0 °C ≤ T<sub>A</sub> ≤ 70 °C; V<sub>DDQ</sub> = 2.5 V ± 0.2 V, V<sub>DD</sub> = +2.5 V ± 0.2 V (DDR333); V<sub>DDQ</sub> = 2.6 V ± 0.1 V, V<sub>DD</sub> = +2.6 V ± 0.1 V (DDR400)
- 2) Input slew rate ≥ 1 V/ns for DDR400, DDR333
- 3) The CK/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<sub>REF</sub>. CK/CK slew rate are ≥ 1.0 V/ns.
- 4) Inputs are not recognized as valid until V<sub>REF</sub> stabilizes.
- 5) The Output timing reference level, as measured at the timing reference point indicated in AC Characteristics (note 3) is V<sub>TT</sub>.
- 6) For each of the terms, if not already an integer, round to the next highest integer. t<sub>CK</sub> is equal to the actual system clock cycle time.
- 7) t<sub>HZ</sub> and t<sub>LZ</sub> 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).

HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

- 8) A maximum of eight Autorefresh commands can be posted to any given DDR SDRAM device.
- 9) These parameters guarantee device timing, but they are not necessarily tested on each device.
- 10) Fast slew rate  $\geq 1.0$  V/ns , slow slew rate  $\geq 0.5$  V/ns and  $< 1$  V/ns for command/address and CK &  $\overline{\text{CK}}$  slew rate  $> 1.0$  V/ns, measured between  $V_{\text{OH(ac)}}$  and  $V_{\text{OL(ac)}}$ .
- 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 tDQSS.
- 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 18 “SPD Codes for HYS64D32301HU-[5/6]-C” on Page 29
- Table 19 “SPD Codes for HYS[72/64]D64300HU-[5/6]-C” on Page 32
- Table 20 “SPD Codes for HYS[64/72]D128320HU-[5/6]-C” on Page 36

**TABLE 18**  
SPD Codes for HYS64D32301HU-[5/6]-C

Product Type		HYS64D32301HU-5-C	HYS64D32301HU-6-C
Organization		256MB	256MB
		×64	×64
		1 Rank (×16)	1 Rank (×16)
Label Code		PC3200U-30331	PC2700U-25331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX
0	Programmed SPD Bytes in E <sup>2</sup> PROM	80	80
1	Total number of Bytes in E <sup>2</sup> PROM	08	08
2	Memory Type (DDR = 07h)	07	07
3	Number of Row Addresses	0D	0D
4	Number of Column Addresses	0A	0A
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 <sub>CK</sub> @ CL <sub>max</sub> (Byte 18) [ns]	50	60
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (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 <sub>CCD</sub> [cycles]	01	01
16	Burst Length Supported	0E	0E
17	Number of Banks on SDRAM Device	04	04
18	CAS Latency	1C	0C
19	CS Latency	01	01



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

<b>Product Type</b>		<b>HYS64D32301HU-5-C</b>	<b>HYS64D32301HU-6-C</b>
<b>Organization</b>		<b>256MB</b>	<b>256MB</b>
		<b>×64</b>	<b>×64</b>
		<b>1 Rank (×16)</b>	<b>1 Rank (×16)</b>
<b>Label Code</b>		<b>PC3200U-30331</b>	<b>PC2700U-25331</b>
<b>JEDEC SPD Revision</b>		<b>Rev. 1.0</b>	<b>Rev. 1.0</b>
<b>Byte#</b>	<b>Description</b>	<b>HEX</b>	<b>HEX</b>
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	75
24	$t_{AC}$ SDRAM @ $CL_{max} -0.5$ [ns]	70	70
25	$t_{CK} @ CL_{max} -1$ (Byte 18) [ns]	75	00
26	$t_{AC}$ SDRAM @ $CL_{max} -1$ [ns]	70	00
27	$t_{RPmin}$ [ns]	3C	48
28	$t_{RRDmin}$ [ns]	28	30
29	$t_{RCDmin}$ [ns]	3C	48
30	$t_{RASmin}$ [ns]	28	2A
31	Module Density per Rank	40	40
32	$t_{AS}, t_{CS}$ [ns]	60	75
33	$t_{AH}, t_{CH}$ [ns]	60	75
34	$t_{DS}$ [ns]	40	45
35	$t_{DH}$ [ns]	40	45
36 - 40	Not used	00	00
41	$t_{RCmin}$ [ns]	37	3C
42	$t_{RFCmin}$ [ns]	41	48
43	$t_{CKmax}$ [ns]	28	30
44	$t_{DQSQmax}$ [ns]	28	2D
45	$t_{QHSmax}$ [ns]	50	55
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	76	1A
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





HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

<b>Product Type</b>		<b>HYS64D32301HU-5-C</b>	<b>HYS64D32301HU-6-C</b>
<b>Organization</b>		<b>256MB</b>	<b>256MB</b>
		<b>×64</b>	<b>×64</b>
		<b>1 Rank (×16)</b>	<b>1 Rank (×16)</b>
<b>Label Code</b>		<b>PC3200U-30331</b>	<b>PC2700U-25331</b>
<b>JEDEC SPD Revision</b>		<b>Rev. 1.0</b>	<b>Rev. 1.0</b>
<b>Byte#</b>	<b>Description</b>	<b>HEX</b>	<b>HEX</b>
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	33	33
79	Part Number, Char 7	30	30
80	Part Number, Char 8	31	31
81	Part Number, Char 9	48	48
82	Part Number, Char 10	55	55
83	Part Number, Char 11	35	36
84	Part Number, Char 12	43	43
85	Part Number, Char 13	20	20
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



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

**TABLE 19**  
SPD Codes for HYS[72/64]D64300HU-[5/6]-C

Product Type		HYS64D64300HU-5-C	HYS64D64300HU-6-C	HYS72D64300HU-5-C	HYS72D64300HU-6-C
Organization		512MB	512MB	512MB	512MB
		×64	×64	×72	×72
		1 Rank (×8)	1 Rank (×8)	1 Rank (×8)	1 Rank (×8)
Label Code		PC3200U-30331	PC2700U-25331	PC3200U-30331	PC2700U-25331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX	HEX
0	Programmed SPD Bytes in E <sup>2</sup> PROM	80	80	80	80
1	Total number of Bytes in E <sup>2</sup> PROM	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	0B	0B	0B	0B
5	Number of DIMM Ranks	01	01	01	01
6	Data Width (LSB)	40	40	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]	50	60	50	60
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (Byte 18) [ns]	70	70	70	70
11	Error Correction Support	00	00	02	02
12	Refresh Rate	82	82	82	82
13	Primary SDRAM Width	08	08	08	08
14	Error Checking SDRAM Width	00	00	08	08
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	1C	0C	1C	0C
19	CS Latency	01	01	01	01
20	Write Latency	02	02	02	02
21	DIMM Attributes	20	20	20	20
22	Component Attributes	C1	C1	C1	C1
23	t <sub>CK</sub> @ CL <sub>max</sub> -0.5 (Byte 18) [ns]	60	75	60	75



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Product Type		HYS64D64300HU-5-C	HYS64D64300HU-6-C	HYS72D64300HU-5-C	HYS72D64300HU-6-C
Organization		512MB	512MB	512MB	512MB
		×64	×64	×72	×72
		1 Rank (×8)	1 Rank (×8)	1 Rank (×8)	1 Rank (×8)
Label Code		PC3200U-30331	PC2700U-25331	PC3200U-30331	PC2700U-25331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX	HEX
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]	75	00	75	00
26	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -1 [ns]	70	00	70	00
27	t <sub>RPmin</sub> [ns]	3C	48	3C	48
28	t <sub>RRDmin</sub> [ns]	28	30	28	30
29	t <sub>RCDmin</sub> [ns]	3C	48	3C	48
30	t <sub>RASmin</sub> [ns]	28	2A	28	2A
31	Module Density per Rank	80	80	80	80
32	t <sub>AS</sub> , t <sub>CS</sub> [ns]	60	75	60	75
33	t <sub>AH</sub> , t <sub>CH</sub> [ns]	60	75	60	75
34	t <sub>DS</sub> [ns]	40	45	40	45
35	t <sub>DH</sub> [ns]	40	45	40	45
36 - 40	Not used	00	00	00	00
41	t <sub>RCmin</sub> [ns]	37	3C	37	3C
42	t <sub>RFCmin</sub> [ns]	41	48	41	48
43	t <sub>CKmax</sub> [ns]	28	30	28	30
44	t <sub>DQSQmax</sub> [ns]	28	2D	28	2D
45	t <sub>QHSmax</sub> [ns]	50	55	50	55
46	not used	00	00	00	00
47	DIMM PCB Height	01	01	01	01
48 - 61	Not used	00	00	00	00
62	SPD Revision	10	10	10	10
63	Checksum of Byte 0-62	AF	53	C1	65
64	Manufacturer's JEDEC ID Code (1)	7F	7F	7F	7F
65	Manufacturer's JEDEC ID Code (2)	7F	7F	7F	7F
66	Manufacturer's JEDEC ID Code (3)	7F	7F	7F	7F



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Product Type		HYS64D64300HU-5-C	HYS64D64300HU-6-C	HYS72D64300HU-5-C	HYS72D64300HU-6-C
Organization		512MB	512MB	512MB	512MB
		×64	×64	×72	×72
		1 Rank (×8)	1 Rank (×8)	1 Rank (×8)	1 Rank (×8)
Label Code		PC3200U-30331	PC2700U-25331	PC3200U-30331	PC2700U-25331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX	HEX
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	36	36	37	37
74	Part Number, Char 2	34	34	32	32
75	Part Number, Char 3	44	44	44	44
76	Part Number, Char 4	36	36	36	36
77	Part Number, Char 5	34	34	34	34
78	Part Number, Char 6	33	33	33	33
79	Part Number, Char 7	30	30	30	30
80	Part Number, Char 8	30	30	30	30
81	Part Number, Char 9	48	48	48	48
82	Part Number, Char 10	55	55	55	55
83	Part Number, Char 11	35	36	35	36
84	Part Number, Char 12	43	43	43	43
85	Part Number, Char 13	20	20	20	20
86	Part Number, Char 14	20	20	20	20
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
92	Test Program Revision Code	xx	xx	xx	xx



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Product Type		HYS64D64300HU-5-C	HYS64D64300HU-6-C	HYS72D64300HU-5-C	HYS72D64300HU-6-C
Organization		512MB	512MB	512MB	512MB
		×64	×64	×72	×72
		1 Rank (×8)	1 Rank (×8)	1 Rank (×8)	1 Rank (×8)
Label Code		PC3200U-30331	PC2700U-25331	PC3200U-30331	PC2700U-25331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX	HEX
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



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

**TABLE 20**  
SPD Codes for HYS[64/72]D128320HU-[5/6]-C

Product Type		HYS64D128320HU-5-C	HYS64D128320HU-6-C	HYS72D128320HU-5-C	HYS72D128320HU-6-C
Organization		1 GByte ×64 2 Ranks (×8)	1 GByte ×64 2 Ranks (×8)	1 GByte ×72 2 Ranks (×8)	1 GByte ×72 2 Ranks (×8)
Label Code		PC3200U-30331	PC2700U-25331	PC3200U-30331	PC2700U-25331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX	HEX
0	Programmed SPD Bytes in E <sup>2</sup> PROM	80	80	80	80
1	Total number of Bytes in E <sup>2</sup> PROM	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	0B	0B	0B	0B
5	Number of DIMM Ranks	02	02	02	02
6	Data Width (LSB)	40	40	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]	50	60	50	60
10	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> (Byte 18) [ns]	70	70	70	70
11	Error Correction Support	00	00	02	02
12	Refresh Rate	82	82	82	82
13	Primary SDRAM Width	08	08	08	08
14	Error Checking SDRAM Width	00	00	08	08
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	1C	0C	1C	0C
19	CS Latency	01	01	01	01
20	Write Latency	02	02	02	02
21	DIMM Attributes	20	20	20	20
22	Component Attributes	C1	C1	C1	C1



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

Product Type		HYS64D128320HU-5-C	HYS64D128320HU-6-C	HYS72D128320HU-5-C	HYS72D128320HU-6-C
Organization		1 GByte	1 GByte	1 GByte	1 GByte
		×64	×64	×72	×72
		2 Ranks (×8)	2 Ranks (×8)	2 Ranks (×8)	2 Ranks (×8)
Label Code		PC3200U-30331	PC2700U-25331	PC3200U-30331	PC2700U-25331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX	HEX
23	t <sub>CK</sub> @ CL <sub>max</sub> -0.5 (Byte 18) [ns]	60	75	60	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]	75	00	75	00
26	t <sub>AC</sub> SDRAM @ CL <sub>max</sub> -1 [ns]	70	00	70	00
27	t <sub>RPmin</sub> [ns]	3C	48	3C	48
28	t <sub>RRDmin</sub> [ns]	28	30	28	30
29	t <sub>RCDmin</sub> [ns]	3C	48	3C	48
30	t <sub>RASmin</sub> [ns]	28	2A	28	2A
31	Module Density per Rank	80	80	80	80
32	t <sub>AS</sub> , t <sub>CS</sub> [ns]	60	75	60	75
33	t <sub>AH</sub> , t <sub>CH</sub> [ns]	60	75	60	75
34	t <sub>DS</sub> [ns]	40	45	40	45
35	t <sub>DH</sub> [ns]	40	45	40	45
36 - 40	Not used	00	00	00	00
41	t <sub>RCmin</sub> [ns]	37	3C	37	3C
42	t <sub>RFCmin</sub> [ns]	41	48	41	48
43	t <sub>CKmax</sub> [ns]	28	30	28	30
44	t <sub>DQSQmax</sub> [ns]	28	2D	28	2D
45	t <sub>QHSmax</sub> [ns]	50	55	50	55
46	not used	00	00	00	00
47	DIMM PCB Height	01	01	01	01
48 - 61	Not used	00	00	00	00
62	SPD Revision	10	10	10	10
63	Checksum of Byte 0-62	B0	54	C2	66
64	Manufacturer's JEDEC ID Code (1)	7F	7F	7F	7F
65	Manufacturer's JEDEC ID Code (2)	7F	7F	7F	7F



HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

<b>Product Type</b>		<b>HYS64D128320HU-5-C</b>	<b>HYS64D128320HU-6-C</b>	<b>HYS72D128320HU-5-C</b>	<b>HYS72D128320HU-6-C</b>
<b>Organization</b>		<b>1 GByte</b>	<b>1 GByte</b>	<b>1 GByte</b>	<b>1 GByte</b>
		<b>×64</b>	<b>×64</b>	<b>×72</b>	<b>×72</b>
		<b>2 Ranks (×8)</b>	<b>2 Ranks (×8)</b>	<b>2 Ranks (×8)</b>	<b>2 Ranks (×8)</b>
<b>Label Code</b>		<b>PC3200U-30331</b>	<b>PC2700U-25331</b>	<b>PC3200U-30331</b>	<b>PC2700U-25331</b>
<b>JEDEC SPD Revision</b>		<b>Rev. 1.0</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>	<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	36	36	37	37
74	Part Number, Char 2	34	34	32	32
75	Part Number, Char 3	44	44	44	44
76	Part Number, Char 4	31	31	31	31
77	Part Number, Char 5	32	32	32	32
78	Part Number, Char 6	38	38	38	38
79	Part Number, Char 7	33	33	33	33
80	Part Number, Char 8	32	32	32	32
81	Part Number, Char 9	30	30	30	30
82	Part Number, Char 10	48	48	48	48
83	Part Number, Char 11	55	55	55	55
84	Part Number, Char 12	35	36	35	36
85	Part Number, Char 13	43	43	43	43
86	Part Number, Char 14	20	20	20	20
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





HYS[64/72]D[16/32/128]3xxHU-[5/6]-C  
Unbuffered DDR SDRAM Modules

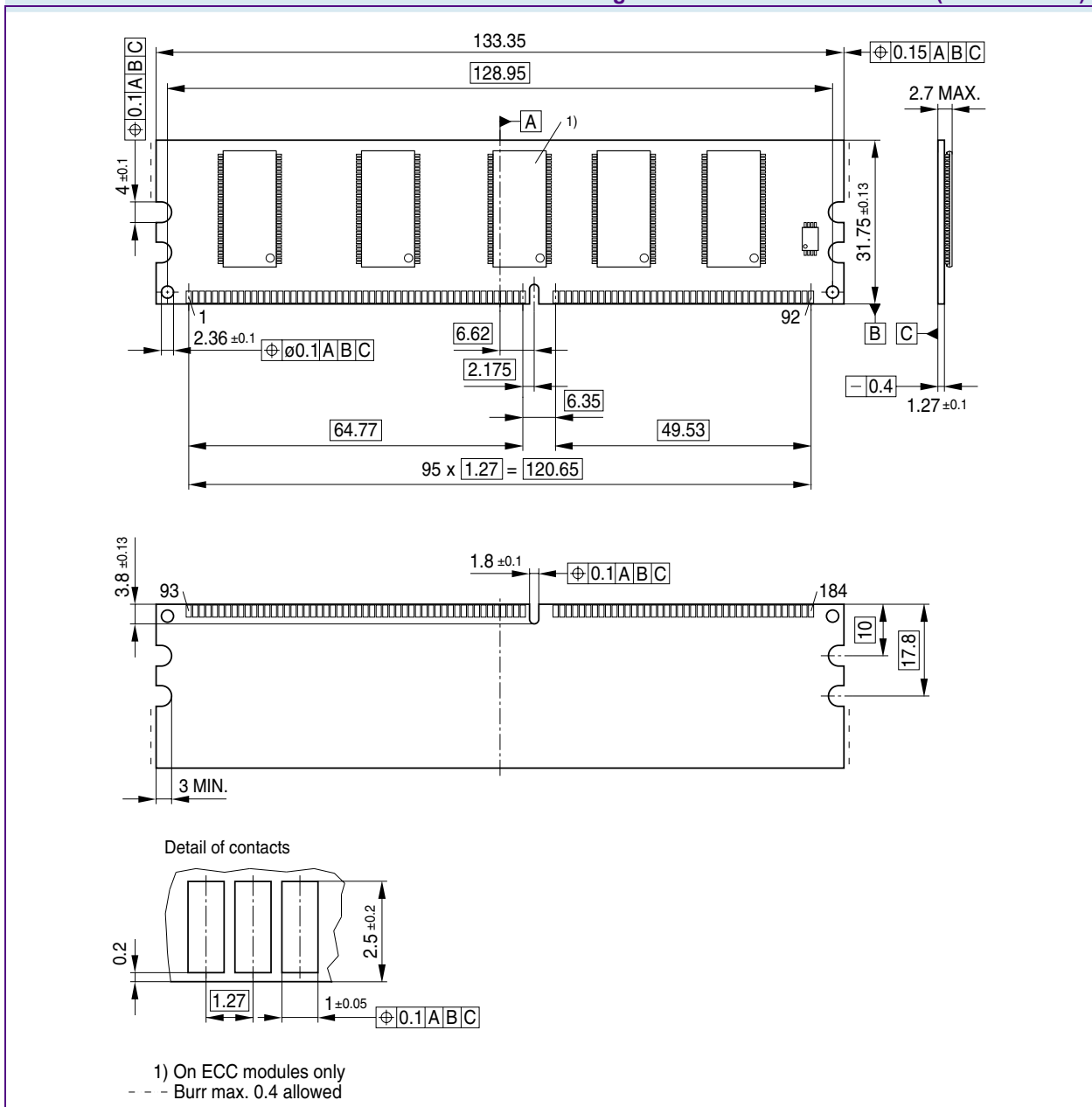
Product Type		HYS64D128320HU-5-C	HYS64D128320HU-6-C	HYS72D128320HU-5-C	HYS72D128320HU-6-C
Organization		1 GByte	1 GByte	1 GByte	1 GByte
		×64	×64	×72	×72
		2 Ranks (×8)	2 Ranks (×8)	2 Ranks (×8)	2 Ranks (×8)
Label Code		PC3200U-30331	PC2700U-25331	PC3200U-30331	PC2700U-25331
JEDEC SPD Revision		Rev. 1.0	Rev. 1.0	Rev. 1.0	Rev. 1.0
Byte#	Description	HEX	HEX	HEX	HEX
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



# 5 Package Outlines

Package Outline for HYS64D32301HU-[5/6]-C

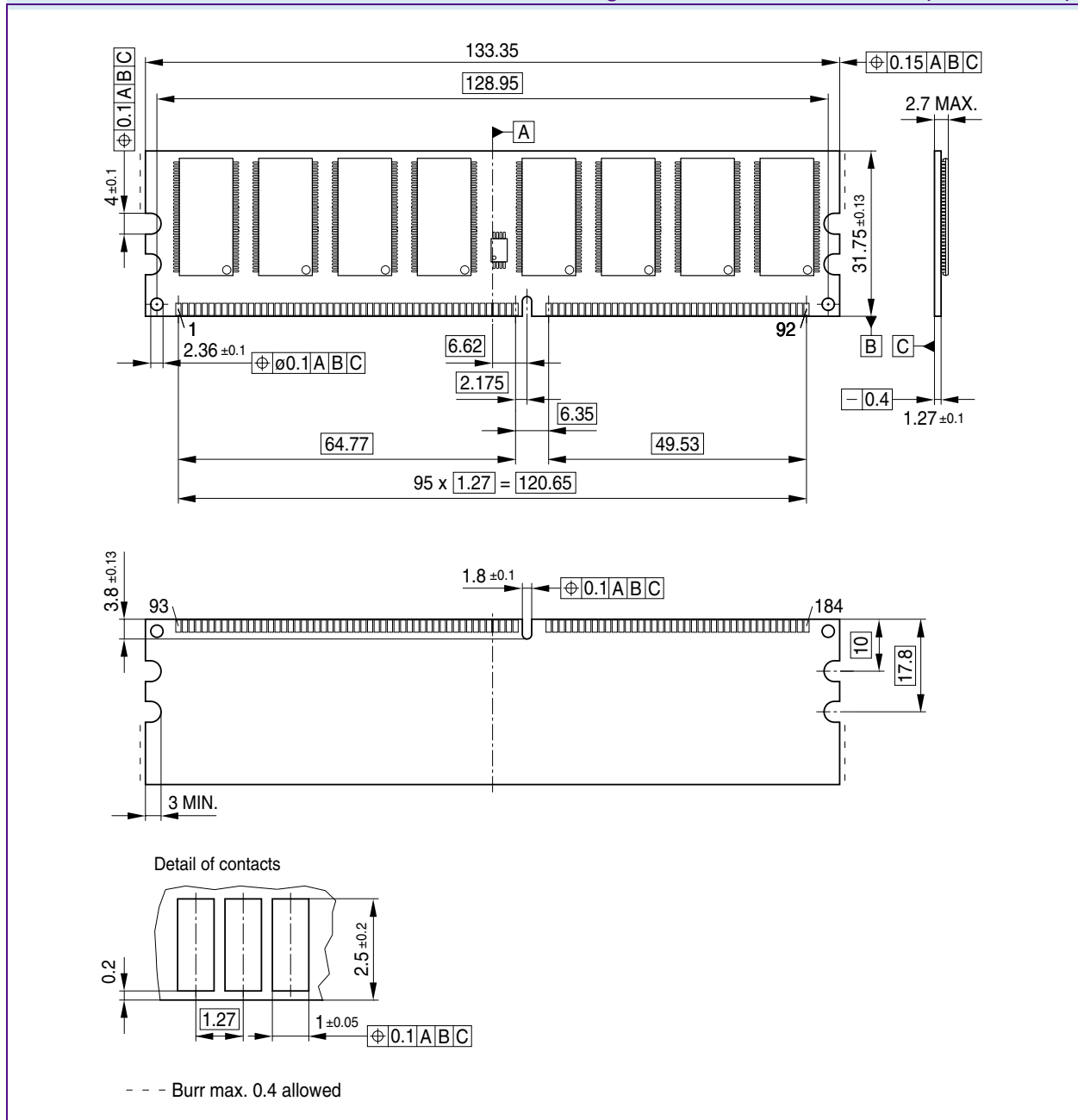
**FIGURE 8**  
Package Outline UDIMM Raw Card C (L-DIM-184-18)





Package Outline for HYS64D64300HU-[5/6]-C

**FIGURE 9**  
Package Outline UDIMM Raw Card A (L-DIM-184-32)

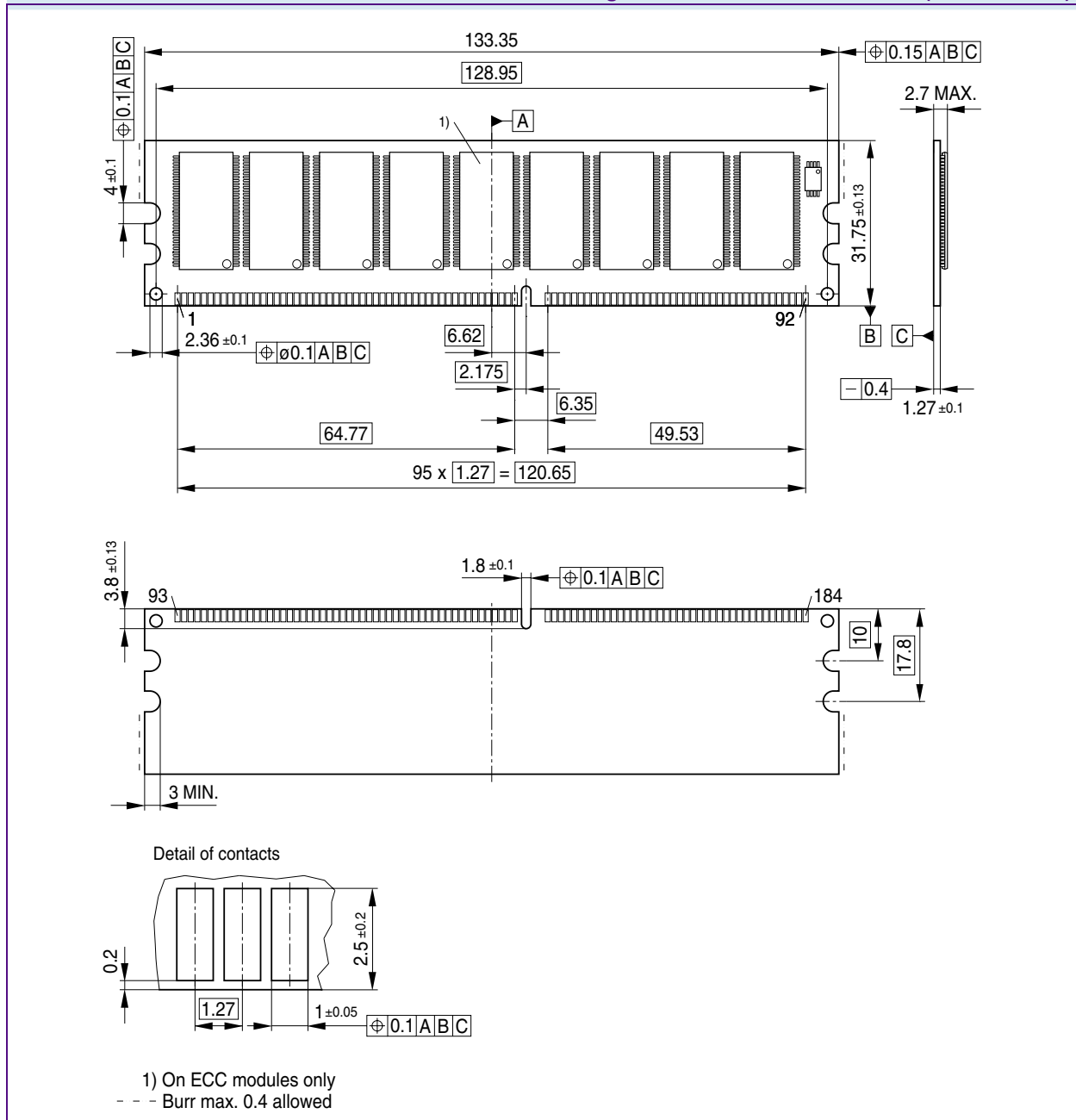




Package Outline for HYS72D64300HU-[5/6]-C

**FIGURE 10**

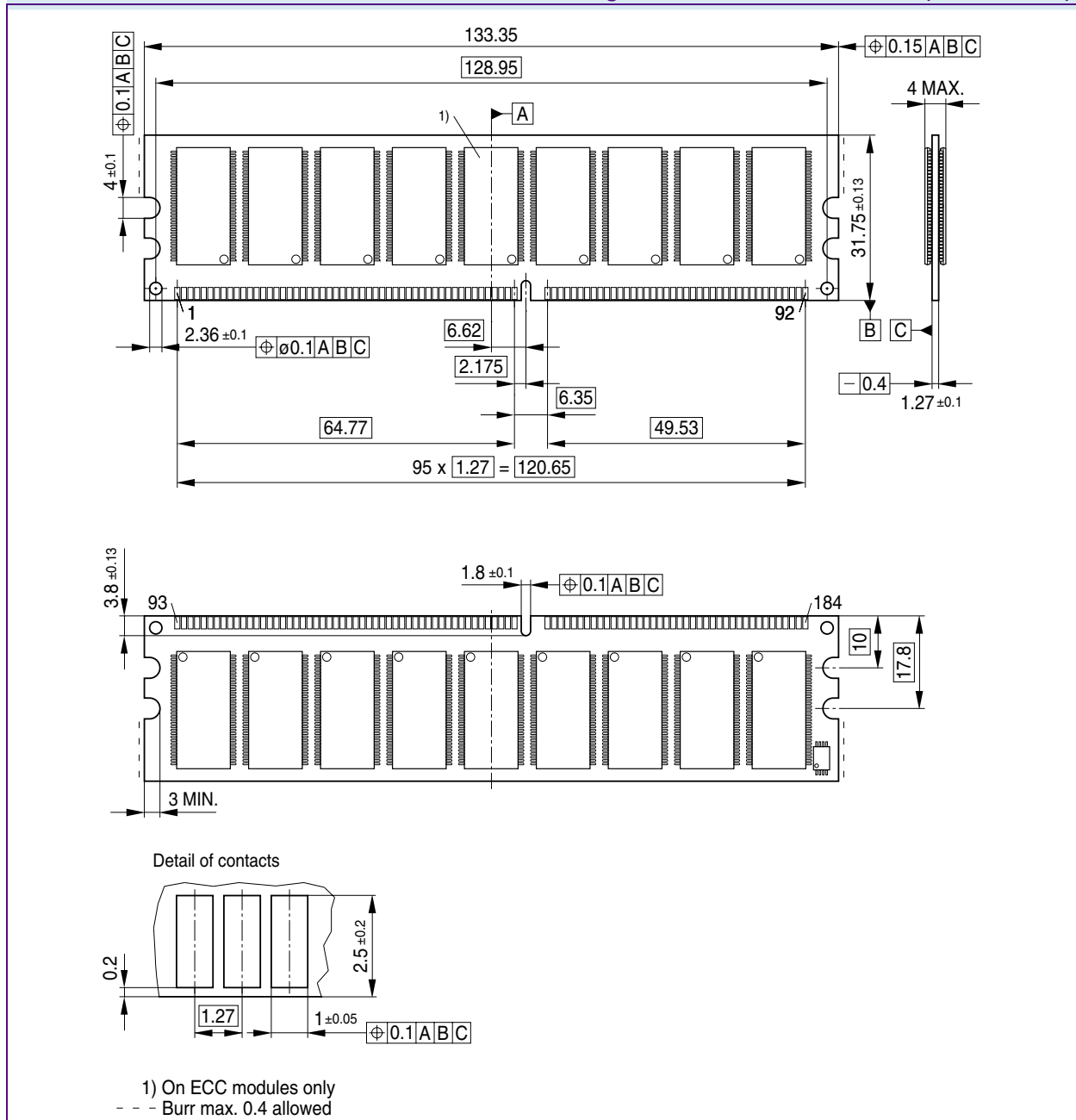
**Package Outline UDIMM Raw Card A (L-DIM-184-30)**





Package Outline for HYS[64/72]D128320HU-[5/6]-C

**FIGURE 11**  
Package Outline UDIMM Raw Card B (L-DIM-184-31)





# Table of Contents

<b>1</b>	<b>Overview</b> .....	<b>3</b>
1.1	Features .....	3
1.2	Description .....	4
<b>2</b>	<b>Pin Configuration</b> .....	<b>5</b>
<b>3</b>	<b>Electrical Characteristics</b> .....	<b>16</b>
3.1	Operating Conditions .....	16
3.2	$I_{DD}$ Specification and Conditions .....	18
3.3	AC Characteristics .....	21
<b>4</b>	<b>SPD Codes</b> .....	<b>24</b>
<b>5</b>	<b>Package Outlines</b> .....	<b>35</b>
	<b>Table of Contents</b> .....	<b>39</b>

**Edition 2006-09**  
**Published by Qimonda AG**  
**Gustav-Heinemann-Ring 212**  
**D-81739 München, Germany**  
**© Qimonda AG 2006.**  
**All Rights Reserved.**

#### **Legal Disclaimer**

The information given in this Internet Data Sheet shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie"). With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Qimonda hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

#### **Information**

For further information on technology, delivery terms and conditions and prices please contact your nearest Qimonda Office.

#### **Warnings**

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Qimonda Office.

Qimonda Components may only be used in life-support devices or systems with the express written approval of Qimonda, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

[www.qimonda.com](http://www.qimonda.com)