

HYS64T32000HU-[3/3S/3.7/5]-A  
HYS[64/72]T64000HU-[3/3S/3.7/5]-A  
HYS[64/72]T128020HU-[3/3S/3.7/5]-A

240-Pin Unbuffered DDR2 SDRAM Modules

UDIMM  
DDR2 SDRAM  
RoHS Compliant

Memory Products



N e v e r   s t o p   t h i n k i n g .

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Page	Subjects (major changes since last revision)
45	updated SPD code byte 49
Previous Version: 2005-03 Rev. 1.2	
	Changed ECC module-label to 'E' instead of 'U'

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## Table of Contents

<b>1</b>	<b>Overview</b>	<b>5</b>
1.1	Features	5
1.2	Description	6
<b>2</b>	<b>Pin Configurations and Block Diagrams</b>	<b>9</b>
<b>3</b>	<b>Pin Configuration</b>	<b>9</b>
3.1	Block Diagrams	19
<b>4</b>	<b>Electrical Characteristics</b>	<b>28</b>
4.1	Absolute Maximum Ratings	28
4.2	DC Operating Conditions	28
4.3	AC Characteristics	30
4.4	Currents Specifications and Conditions	37
<b>5</b>	<b>SPD Codes</b>	<b>45</b>
<b>6</b>	<b>Package Outlines</b>	<b>61</b>
<b>7</b>	<b>Product Type Nomenclature (DDR2 DRAMs and DIMMs)</b>	<b>68</b>

## 240-Pin Unbuffered DDR2 SDRAM Modules UDIMM

HYS64T32000HU-[3/3S/3.7/5]-A  
HYS[64/72]T64000HU-[3/3S/3.7/5]-A  
HYS[64/72]T128020HU-[3/3S/3.7/5]-A

# 1 Overview

This chapter gives an overview of the 240-Pin Unbuffered DDR2 SDRAM Modules product family and describes its main characteristics.

## 1.1 Features

- 240-Pin PC2-5300, PC2-4200 and PC2-3200 DDR2 SDRAM memory modules for use as main memory when installed in systems such as mobile personal computers.
- 32M × 64, 64M × 64, 64M × 72, 128M × 64, 128M × 72 module organization, and 32M × 16, 64M × 8 chip organization
- 256 MByte, 512 MByte and 1 GByte modules built with 512-Mbit DDR2 SDRAMs in P-TFBGA-60 and P-TFBGA-84 chipsize packages
- All Speed grades faster than DDR2-400 comply with DDR2-400 timing specifications.
- Standard Double-Data-Rate-Two Synchronous DRAMs (DDR2 SDRAM) with a single + 1.8 V (± 0.1 V) power supply
- Programmable CAS Latencies (3, 4 and 5), Burst Length (8 & 4) and Burst Type
- Auto Refresh (CBR) and Self Refresh
- All inputs and outputs SSTL\_1.8 compatible
- Off-Chip Driver Impedance Adjustment (OCD) and On-Die Termination (ODT)
- Serial Presence Detect with E<sup>2</sup>PROM
- Dimensions (nominal):  
30 mm high, 133.35 mm wide
- Based on standard reference layouts Raw Card "A", "B", "C", "D", "E", "F" and "G"
- RoHS compliant products<sup>1)</sup>

**Table 1 Performance for DDR2-667**

Product Type Speed Code			-3	-3S	Unit
Speed Grade			PC2-5300 4-4-4	PC2-5300 5-5-5	—
max. Clock Frequency	@CL5	$f_{CK5}$	333	333	MHz
	@CL4	$f_{CK4}$	333	266	MHz
	@CL3	$f_{CK3}$	200	200	MHz
min. RAS-CAS-Delay		$t_{RCD}$	12	15	ns
min. Row Precharge Time		$t_{RP}$	12	15	ns
min. Row Active Time		$t_{RAS}$	45	45	ns
min. Row Cycle Time		$t_{RC}$	57	60	ns

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.

**Table 2 Performance for DDR2-533 and DDR2-400**

Product Type Speed Code			-3.7	-5	Units
Speed Grade			PC2-4200 4-4-4	PC2-3200 3-3-3	—
Max. Clock Frequency	@CL5	$f_{CK5}$	266	200	MHz
	@CL4	$f_{CK4}$	266	200	MHz
	@CL3	$f_{CK3}$	200	200	MHz
Min. RAS-CAS-Delay		$t_{RCD}$	15	15	ns
Min. Row Precharge Time		$t_{RP}$	15	15	ns
Min. Row Active Time		$t_{RAS}$	45	40	ns
Min. Row Cycle Time		$t_{RC}$	60	55	ns

## 1.2 Description

The INFINEON HYS[64/72]T[32/64/128]0[0/2]0HU-[3/3S/3.7/5]-A module family are unbuffered DIMM modules "UDIMMs" with 30,0 mm height based on DDR2 technology. DIMMs are available as non-ECC modules in  $32M \times 64$  (256MB),  $64M \times 64$  (512MB),  $128M \times 64$  (1GB) and as ECC modules in  $64M \times 72$  (512MB),  $128M \times 72$  (1GB) organization and density, intended for mounting into 240-pin connector sockets.

The memory array is designed with 512-Mbit Double-Data-Rate-Two (DDR2) Synchronous DRAMs. Decoupling capacitors are mounted on the PCB 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 are write protected; the second 128 bytes are available to the customer.



**Table 3 Ordering Information for RoHS Compliant Products**

Product Type <sup>1)</sup>	Compliance Code <sup>2)</sup>	Description	SDRAM Technology
<b>PC2-5300</b>			
HYS64T32000HU-3-A	256MB 1R×16 PC2-5300U-444-12-C1	1 Rank, Non-ECC	512 Mbit (×16)
HYS64T64000HU-3-A	512MB 1R×8 PC2-5300U-444-12-D0	1 Rank, Non-ECC	512 Mbit (×8)
HYS72T64000HU-3-A	512MB 1R×8 PC2-5300E-444-12-F0	1 Rank, ECC	512 Mbit (×8)
HYS64T128020HU-3-A	1GB 2R×8 PC2-5300U-444-12-E0	2 Ranks, Non-ECC	512 Mbit (×8)
HYS72T128020HU-3-A	1GB 2R×8 PC2-5300E-444-12-G0	2 Ranks, ECC	512 Mbit (×8)
HYS64T32000HU-3S-A	256MB 1R×16 PC2-5300U-555-12-C1	1 Rank, Non-ECC	512 Mbit (×16)
HYS64T64000HU-3S-A	512MB 1R×8 PC2-5300U-555-12-D0	1 Rank, Non-ECC	512 Mbit (×8)
HYS72T64000HU-3S-A	512MB 1R×8 PC2-5300E-555-12-F0	1 Rank, ECC	512 Mbit (×8)
HYS64T128020HU-3S-A	1GB 2R×8 PC2-5300U-555-12-E0	2 Ranks, Non-ECC	512 Mbit (×8)
HYS72T128020HU-3S-A	1GB 2R×8 PC2-5300E-555-12-G0	2 Ranks, ECC	512 Mbit (×8)
<b>PC2-4200</b>			
HYS64T32000HU-3.7-A	256MB 1R×16 PC2-4200U-444-11-C1	1 Rank, Non-ECC	512 Mbit (×16)
HYS64T64000HU-3.7-A	512MB 1R×8 PC2-4200U-444-11-A1	1 Rank, Non-ECC	512 Mbit (×8)
HYS72T64000HU-3.7-A	512MB 1R×8 PC2-4200E-444-11-A1	1 Rank, ECC	512 Mbit (×8)
HYS64T128020HU-3.7-A	1GB 2R×8 PC2-4200U-444-11-B1	2 Ranks, Non-ECC	512 Mbit (×8)
HYS72T128020HU-3.7-A	1GB 2R×8 PC2-4200E-444-11-B1	2 Ranks, ECC	512 Mbit (×8)
<b>PC2-3200</b>			
HYS64T32000HU-5-A	256MB 1R×16 PC2-3200U-333-11-C1	1 Rank, Non-ECC	512 Mbit (×16)
HYS64T64000HU-5-A	512MB 1R×8 PC2-3200U-333-11-A1	1 Rank, Non-ECC	512 Mbit (×8)
HYS72T64000HU-5-A	512MB 1R×8 PC2-3200E-333-11-A1	1 Rank, ECC	512 Mbit (×8)
HYS64T128020HU-5-A	1GB 2R×8 PC2-3200U-333-11-B1	2 Ranks, Non-ECC	512 Mbit (×8)
HYS72T128020HU-5-A	1GB 2R×8 PC2-3200E-333-12-B1	2 Ranks, ECC	512 Mbit (×8)

1) All product types end with a place code, designating the silicon die revision. Example: HYS64T64000HU-3-A, indicating Rev. "A" dies are used for DDR2 SDRAM components. For all INFINEON DDR2 module and component nomenclature see [Chapter 7](#) of this data sheet.

2) The Compliance Code is printed on the module label and describes the speed grade, for example "PC2-5300U-444-12-C1", where 4200U means Unbuffered DIMM modules with 4.26 GB/sec Module Bandwidth and "444-12" means Column Address Strobe (CAS) latency = 4, Row Column Delay (RCD) latency = 4 and Row Precharge (RP) latency = 4 using the latest JEDEC SPD Revision 1.2 and produced on the Raw Card "C".

**Table 4 Address Format**

DIMM Density	Module Organization	Memory Ranks	ECC/ Non-ECC	# of SDRAMs	# of row/bank/column bits	Raw Card
256 MByte	32M ×64	1	Non-ECC	4	13/2/10	C
512 MByte	64M ×64	1	Non-ECC	8	14/2/10	A,D
512 MByte	64M ×72	1	ECC	9	14/2/10	A,F
1 GByte	128M ×64	2	Non-ECC	16	14/2/10	B,E
1 GByte	128M ×72	2	ECC	18	14/2/10	B,G

**Table 5 Components on Modules <sup>1)</sup>**

Product Type <sup>2)</sup>	DRAM Components <sup>2)</sup>	DRAM Density	DRAM Organisation
HYS64T32000HU	HYB18T512160AF	512 Mbit	32M × 16
HYS64T64000HU	HYB18T512800AF	512 Mbit	64M × 8
HYS72T64000HU	HYB18T512800AF	512 Mbit	64M × 8
HYS64T128020HU	HYB18T512800AF	512 Mbit	64M × 8
HYS72T128020HU	HYB18T512800AF	512 Mbit	64M × 8

1) For a detailed description of all functionalities of the DRAM components on these modules see the component data sheet.

2) Green Product



## 2 Pin Configurations and Block Diagrams

This chapter contains information to the pin configuration of the modules as well as the block diagrams to the various module organization

## 3 Pin Configuration

The pin configuration of the Unbuffered DDR2 SDRAM DIMM is listed by function in [Table 6](#) (240 pins). The abbreviations used in columns Pin and Buffer Type are explained in [Table 7](#) and [Table 8](#) respectively. The pin numbering is depicted in [Figure 1](#) for non-ECC modules (×64) and [Figure 2](#) for ECC modules (×72).

**Table 6 Pin Configuration of UDIMM**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
<b>Clock Signals</b>				
185	CK0	I	SSTL	<b>Clock Signals 2:0, Complement Clock Signals 2:0</b> The system clock inputs. All address and command lines are sampled on the cross point of the rising edge of CK and the falling edge of $\overline{\text{CK}}$ . A Delay Locked Loop (DLL) circuit is driven from the clock inputs and output timing for read operations is synchronized to the input clock.
137	CK1	I	SSTL	
220	CK2	I	SSTL	
186	$\overline{\text{CK0}}$	I	SSTL	
138	$\overline{\text{CK1}}$	I	SSTL	
221	$\overline{\text{CK2}}$	I	SSTL	
52	CKE0	I	SSTL	<b>Clock Enable Rank 1:0</b> Activates the DDR2 SDRAM CK signal when HIGH and deactivates the CK signal when LOW. By deactivating the clocks, CKE LOW initiates the Power Down Mode or the Self Refresh Mode. <i>Note: 2 Ranks module</i>
171	CKE1	I	SSTL	
	NC	NC	—	<b>Not Connected</b> <i>Note: 1 Rank module</i>
<b>Control Signals</b>				
193	S0	I	SSTL	<b>Chip Select Rank 1:0</b> Enables the associated DDR2 SDRAM command decoder when LOW and disables the command decoder when HIGH. When the command decoder is disabled, new commands are ignored but previous operations continue. Rank 0 is selected by $\overline{\text{S0}}$ ; Rank 1 is selected by $\overline{\text{S1}}$ . Ranks are also called "Physical banks". <i>Note: 2 Ranks module</i>
76	S1	I	SSTL	
	NC	NC	—	
	NC	NC	—	<b>Not Connected</b> <i>Note: 1 Rank module</i>
192	$\overline{\text{RAS}}$	I	SSTL	<b>Row Address Strobe</b> When sampled at the cross point of the rising edge of CK, and falling edge of $\overline{\text{CKRAS}}$ , $\overline{\text{CAS}}$ and $\overline{\text{WE}}$ define the operation to be executed by the SDRAM.
74	$\overline{\text{CAS}}$	I	SSTL	<b>Column Address Strobe</b>
73	$\overline{\text{WE}}$	I	SSTL	<b>Write Enable</b>
<b>Address Signals</b>				

**Table 6 Pin Configuration of UDIMM (cont'd)**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
71	BA0	I	SSTL	<b>Bank Address Bus 1:0</b> Selects which DDR2 SDRAM internal bank of four or eight is activated.
190	BA1	I	SSTL	
54	BA2	I	SSTL	<b>Bank Address Bus 2</b> Greater than 512Mb DDR2 SDRAMS
	NC	NC	—	<b>Not Connected</b> Less than 1Gb DDR2 SDRAMS
188	A0	I	SSTL	<b>Address Bus 12:0</b> During a Bank Activate command cycle, defines the row address when sampled at the crosspoint of the rising edge of CK and falling edge of CK. During a Read or Write command cycle, defines the column address when sampled at the cross point of the rising edge of CK and falling edge of $\overline{CK}$ . In addition to the column address, AP is used to invoke autoprecharge operation at the end of the burst read or write cycle. If AP is HIGH, autoprecharge is selected and BA0-BAn defines the bank to be precharged. If AP is LOW, autoprecharge is disabled. During a Precharge command cycle, AP is used in conjunction with BA0-BAn to control which bank(s) to precharge. If AP is HIGH, all banks will be precharged regardless of the state of BA0-BAn inputs. If AP is LOW, then BA0-BAn are used to define which bank to precharge.
183	A1	I	SSTL	
63	A2	I	SSTL	
182	A3	I	SSTL	
61	A4	I	SSTL	
60	A5	I	SSTL	
180	A6	I	SSTL	
58	A7	I	SSTL	
179	A8	I	SSTL	
177	A9	I	SSTL	
70	A10	I	SSTL	
	AP	I	SSTL	
57	A11	I	SSTL	
176	A12	I	SSTL	
196	A13	I	SSTL	<b>Address Signal 13</b> <i>Note: 1 Gbit based module and 512M <math>\times 4/\times 8</math></i>
	NC	NC	—	<b>Not Connected</b> <i>Note: Module based on 1 Gbit <math>\times 16</math></i> <i>Note: Module based on 512 Mbit <math>\times 16</math> or smaller</i>
174	A14	I	SSTL	<b>Address Signal 14</b> <i>Note: Modules based on 2 Gbit</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: Modules based on 1 Gbit or smaller</i>

**Table 6 Pin Configuration of UDIMM (cont'd)**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
<b>Data Signals</b>				
3	DQ0	I/O	SSTL	<b>Data Bus 63:0</b> Data Input/Output pins
4	DQ1	I/O	SSTL	
9	DQ2	I/O	SSTL	
10	DQ3	I/O	SSTL	
122	DQ4	I/O	SSTL	
123	DQ5	I/O	SSTL	
128	DQ6	I/O	SSTL	
129	DQ7	I/O	SSTL	
12	DQ8	I/O	SSTL	
13	DQ9	I/O	SSTL	
21	DQ10	I/O	SSTL	
22	DQ11	I/O	SSTL	
131	DQ12	I/O	SSTL	
132	DQ13	I/O	SSTL	
140	DQ14	I/O	SSTL	
141	DQ15	I/O	SSTL	

**Table 6 Pin Configuration of UDIMM (cont'd)**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
24	DQ16	I/O	SSTL	<b>Data Bus 63:0</b> Data Input/Output pins
25	DQ17	I/O	SSTL	
30	DQ18	I/O	SSTL	
31	DQ19	I/O	SSTL	
143	DQ20	I/O	SSTL	
144	DQ21	I/O	SSTL	
149	DQ22	I/O	SSTL	
150	DQ23	I/O	SSTL	
33	DQ24	I/O	SSTL	
34	DQ25	I/O	SSTL	
39	DQ26	I/O	SSTL	
40	DQ27	I/O	SSTL	
152	DQ28	I/O	SSTL	
153	DQ29	I/O	SSTL	
158	DQ30	I/O	SSTL	
159	DQ31	I/O	SSTL	
80	DQ32	I/O	SSTL	
81	DQ33	I/O	SSTL	
86	DQ34	I/O	SSTL	
87	DQ35	I/O	SSTL	
199	DQ36	I/O	SSTL	
200	DQ37	I/O	SSTL	
205	DQ38	I/O	SSTL	
206	DQ39	I/O	SSTL	
89	DQ40	I/O	SSTL	
90	DQ41	I/O	SSTL	
95	DQ42	I/O	SSTL	
96	DQ43	I/O	SSTL	
208	DQ44	I/O	SSTL	
209	DQ45	I/O	SSTL	
214	DQ46	I/O	SSTL	
215	DQ47	I/O	SSTL	
98	DQ48	I/O	SSTL	
99	DQ49	I/O	SSTL	
107	DQ50	I/O	SSTL	
108	DQ51	I/O	SSTL	
217	DQ52	I/O	SSTL	
218	DQ53	I/O	SSTL	
226	DQ54	I/O	SSTL	
227	DQ55	I/O	SSTL	

Table 6 Pin Configuration of UDIMM (cont'd)

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
110	DQ56	I/O	SSTL	<b>Data Bus 63:0</b> Data Input/Output pins
111	DQ57	I/O	SSTL	
116	DQ58	I/O	SSTL	
117	DQ59	I/O	SSTL	
229	DQ60	I/O	SSTL	
230	DQ61	I/O	SSTL	
235	DQ62	I/O	SSTL	
236	DQ63	I/O	SSTL	
Check Bit Signals				
42	CB0	I/O	SSTL	<b>Check Bit 0</b> <i>Note: ECC type module only</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: ECC type module only</i>
43	CB1	I/O	SSTL	<b>Check Bit 1</b> <i>Note: ECC type module only</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: ECC type module only</i>
48	CB2	I/O	SSTL	<b>Check Bit 2</b> <i>Note: ECC type module only</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: ECC type module only</i>
49	CB3	I/O	SSTL	<b>Check Bit 3</b> <i>Note: ECC type module only</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: ECC type module only</i>
161	CB4	I/O	SSTL	<b>Check Bit 4</b> <i>Note: ECC type module only</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: ECC type module only</i>
162	CB5	I/O	SSTL	<b>Check Bit 5</b> <i>Note: ECC type module only</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: ECC type module only</i>
167	CB6	I/O	SSTL	<b>Check Bit 6</b> <i>Note: ECC type module only</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: ECC type module only</i>

Table 6 Pin Configuration of UDIMM (cont'd)

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
168	CB7	I/O	SSTL	<b>Check Bit 7</b> <i>Note: ECC type module only</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: Non-ECC module</i>

#### Data Strobe Bus

7	DQS0	I/O	SSTL	<b>Data Strobe Bus 8:0</b> The data strobes, associated with one data byte, sourced with data transfers. In Write mode, the data strobe is sourced by the controller and is centered in the data window. In Read mode the data strobe is sourced by the DDR2 SDRAM and is sent at the leading edge of the data window. $\overline{DQS}$ signals are complements, and timing is relative to the crosspoint of respective DQS and $\overline{DQS}$ . If the module is to be operated in single ended strobe mode, all $\overline{DQS}$ signals must be tied on the system board to $V_{SS}$ and DDR2 SDRAM mode registers programmed appropriately. <i>Note: See block diagram for corresponding DQ signals</i>
16	DQS1	I/O	SSTL	
28	DQS2	I/O	SSTL	
37	DQS3	I/O	SSTL	
84	DQS4	I/O	SSTL	
93	DQS5	I/O	SSTL	
105	DQS6	I/O	SSTL	
114	DQS7	I/O	SSTL	
46	DQS8	I/O	SSTL	<b>Complement Data Strobe Bus 8:0</b> <i>Note: See block diagram for corresponding DQ signals</i>
6	$\overline{DQS0}$	I/O	SSTL	
15	$\overline{DQS1}$	I/O	SSTL	
27	$\overline{DQS2}$	I/O	SSTL	
36	$\overline{DQS3}$	I/O	SSTL	
83	$\overline{DQS4}$	I/O	SSTL	
92	$\overline{DQS5}$	I/O	SSTL	
104	$\overline{DQS6}$	I/O	SSTL	
113	$\overline{DQS7}$	I/O	SSTL	
45	$\overline{DQS8}$	I/O	SSTL	

#### Data Mask Signals

125	DM0	I	SSTL	<b>Data Mask Bus 8:0</b> The data write masks, associated with one data byte. In Write mode, DM operates as a byte mask by allowing input data to be written if it is LOW but blocks the write operation if it is HIGH. In Read mode, DM lines have no effect. <i>Note: See block diagram for corresponding DQ M signals</i>
134	DM1	I	SSTL	
146	DM2	I	SSTL	
155	DM3	I	SSTL	
202	DM4	I	SSTL	
211	DM5	I	SSTL	
223	DM6	I	SSTL	
232	DM7	I	SSTL	
164	DM8	I	SSTL	

#### EEPROM

120	SCL	I	CMOS	<b>Serial Bus Clock</b> This signal is used to clock data into and out of the SPD EEPROM.
119	SDA	I/O	OD	<b>Serial Bus Data</b> This is a bidirectional pin used to transfer data into or out of the SPD EEPROM. A resistor must be connected from SDA to $V_{DDSPD}$ on the motherboard to act as a pull-up.

**Table 6 Pin Configuration of UDIMM (cont'd)**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
239	SA0	I	CMOS	<b>Serial Address Select Bus 2:0</b> Address pins used to select the Serial Presence Detect base address.
240	SA1	I	CMOS	
101	SA2	I	CMOS	

**Power Supplies**

1	$V_{REF}$	AI	—	<b>I/O Reference Voltage</b> Reference voltage for the SSTL-18 inputs.
238	$V_{DDSPD}$	PWR	—	<b>EEPROM Power Supply</b> Power supplies for core, I/O, Serial Presence Detect, and ground for the module.
51,56,62,72,75, 78,170,175,181, 191,194	$V_{DDQ}$	PWR	—	<b>I/O Driver Power Supply</b>
53,59,64,67,69, 172,178,184,187, 189,197	$V_{DD}$	PWR	—	<b>Power Supply</b> Power supplies for core, I/O, Serial Presence Detect, and ground for the module.
2,5,8,11,14,17, 20,23,26,29,32, 35,38,41,44,47, 50,65,66,79,82, 85,88,91,94,97, 100,103,106, 109,112,115,118, 121,124,127, 130,133,136,139, 142,145,148, 151,154,157,160, 163,166,169, 198,201,204,207, 210,213,216, 219,222,225,228, 231,234,237	$V_{SS}$	GND	—	<b>Ground Plane</b> Power supplies for core, I/O, Serial Presence Detect, and ground for the module.

**Other Pins**

195	ODT0	I	SSTL	<b>On-Die Termination Control 0</b>
77	ODT1	I	SSTL	<b>On-Die Termination Control 1</b> Asserts on-die termination for DQ, DM, DQS, and $\overline{DQS}$ signals if enabled via the DDR2 SDRAM mode register. <i>Note: 2 Rank modules</i>
	NC	NC	—	<b>Not Connected</b> <i>Note: 1 Rank modules</i>
18,19,55,68,102, 126,135,147, 156,165,173,203, 212, 224,233	NC	NC	—	<b>Not connected</b> <i>Note: Pins not connected on Infineon UDIMMs</i>

**Table 7 Abbreviations for Pin Type**

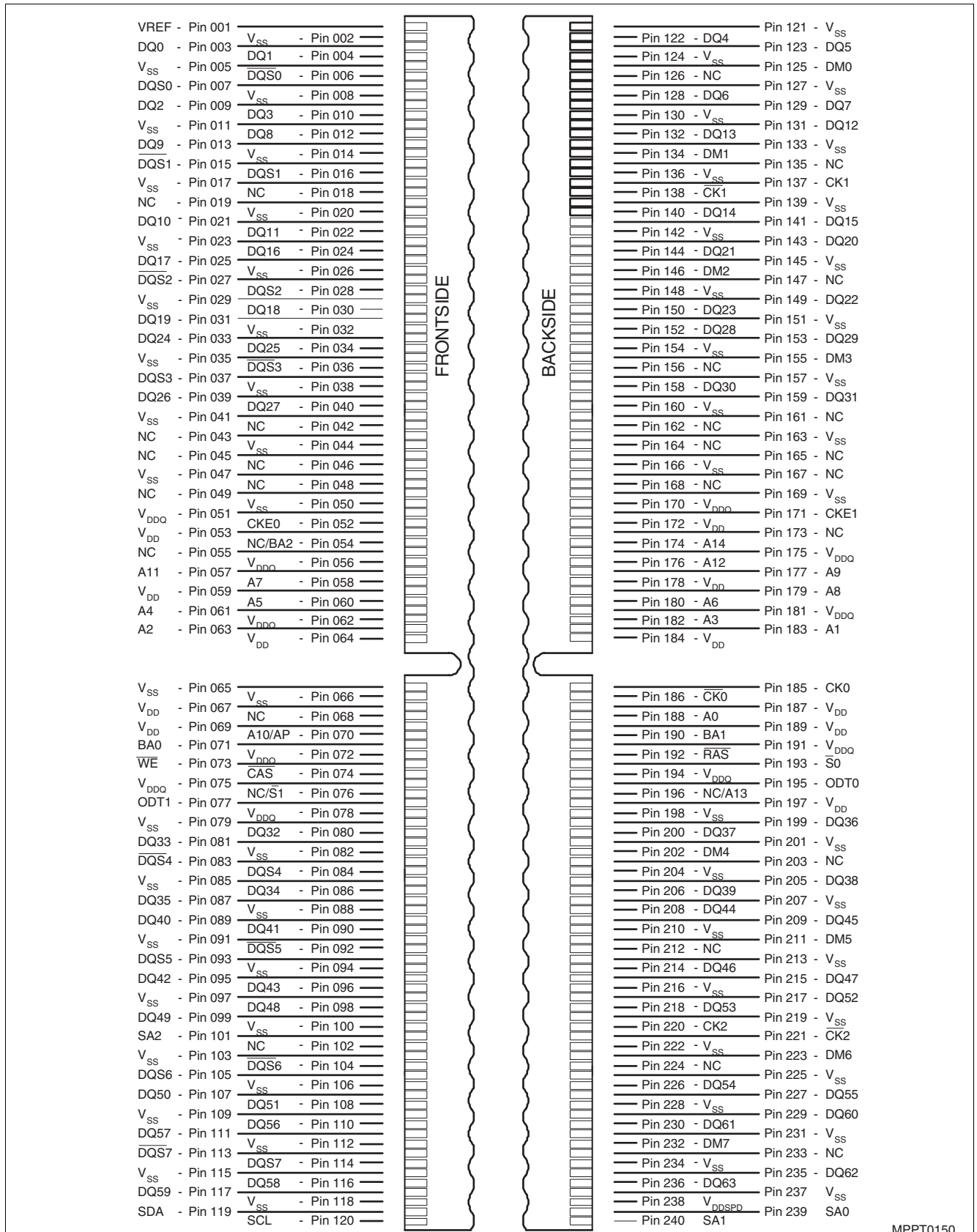
Abbreviation	Description
I	Standard input-only pin. Digital levels.
O	Output. Digital levels.
I/O	I/O is a bidirectional input/output signal.
AI	Input. Analog levels.
PWR	Power
GND	Ground
NC	Not Connected

**Table 8 Abbreviations for Buffer Type**

Abbreviation	Description
SSTL	Serial Stub Terminated Logic (SSTL_18)
LV-CMOS	Low Voltage CMOS
CMOS	CMOS Levels
OD	Open Drain. The corresponding pin has 2 operational states, active low and tri-state, and allows multiple devices to share as a wire-OR.



### Pin Configuration



MPPT0150

Figure 1 Pin Configuration UDIMM x64 (240 Pin)

### Pin Configuration

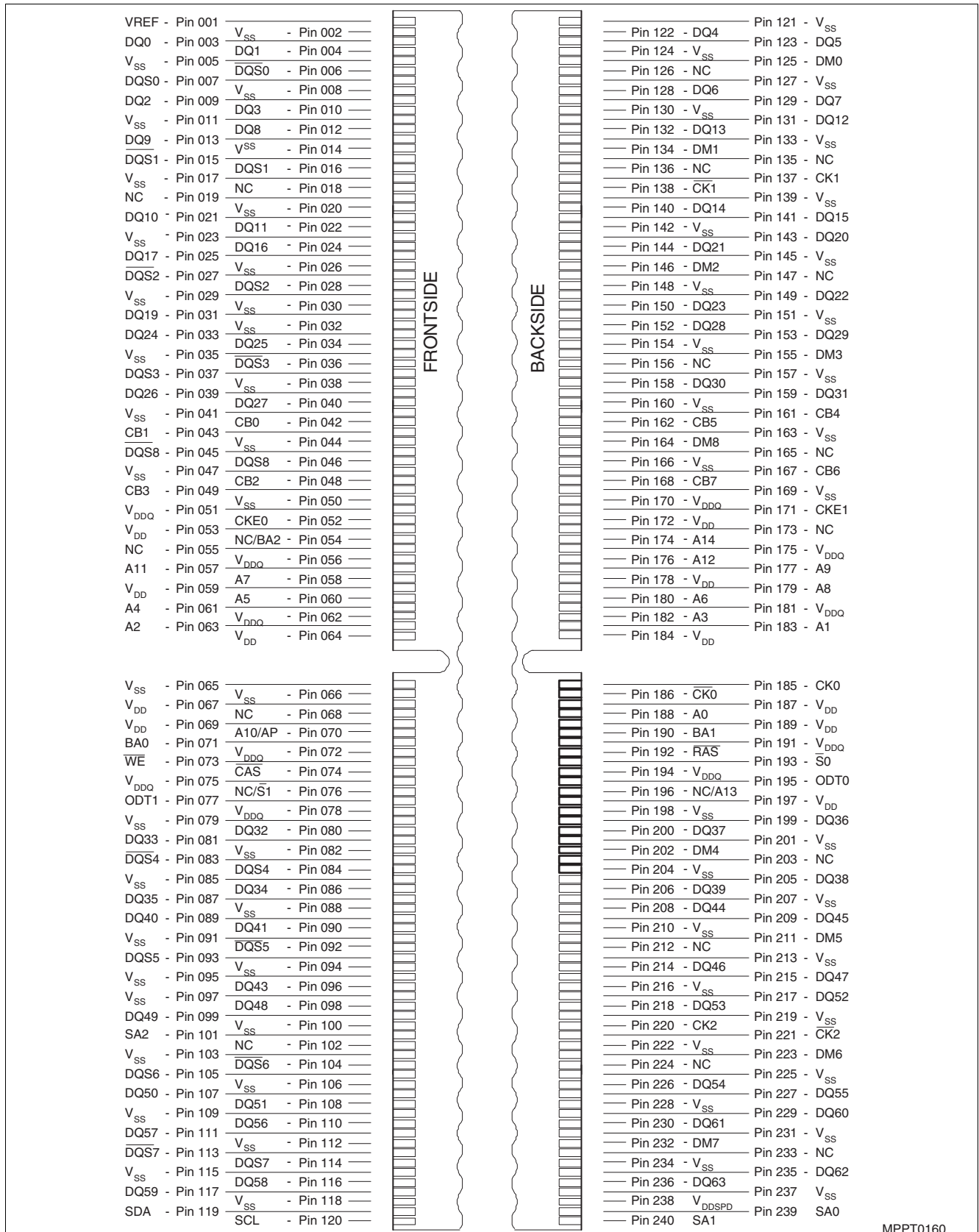


Figure 2 Pin Configuration UDIMM x72 (240 Pin)

### 3.1 Block Diagrams

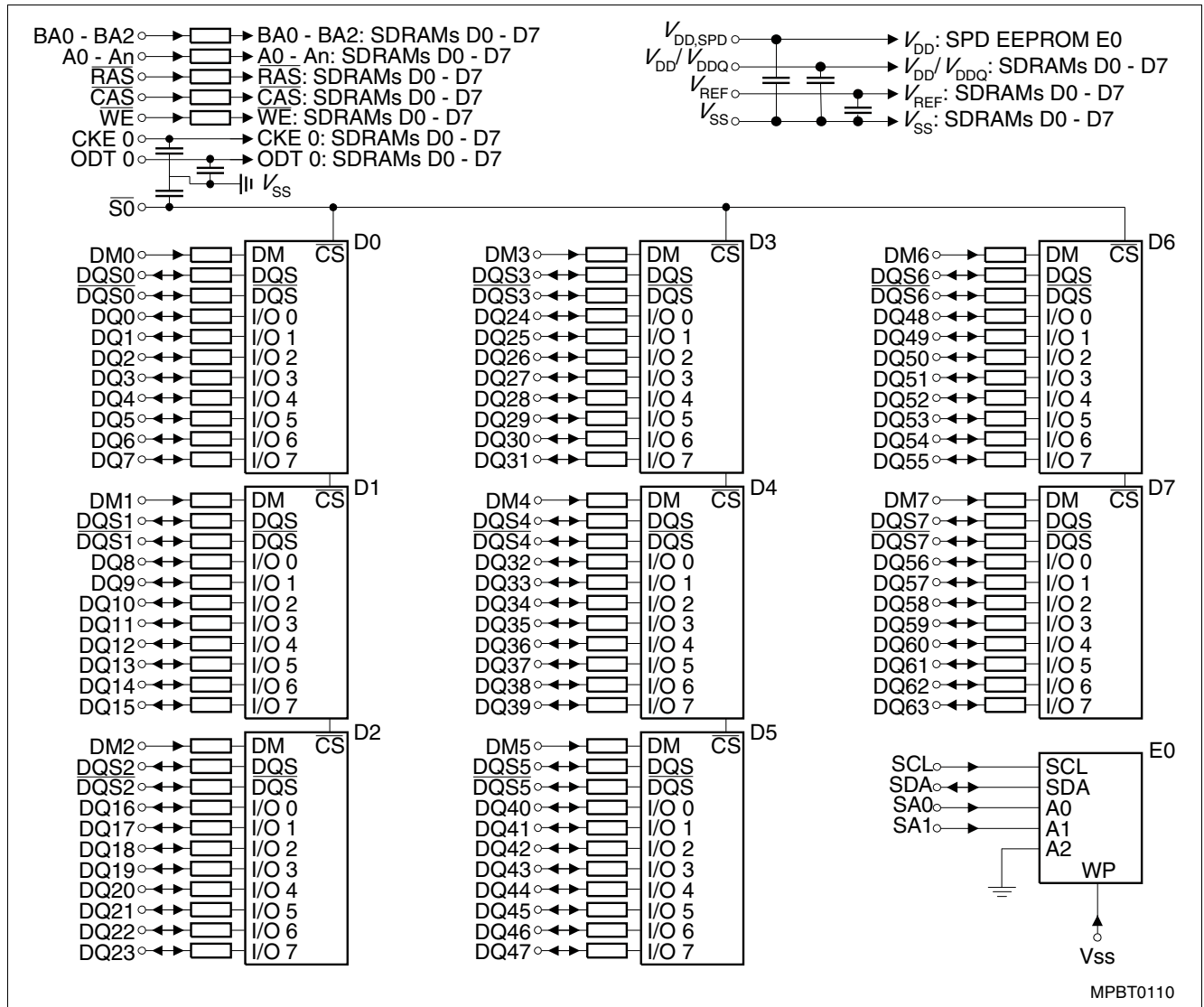


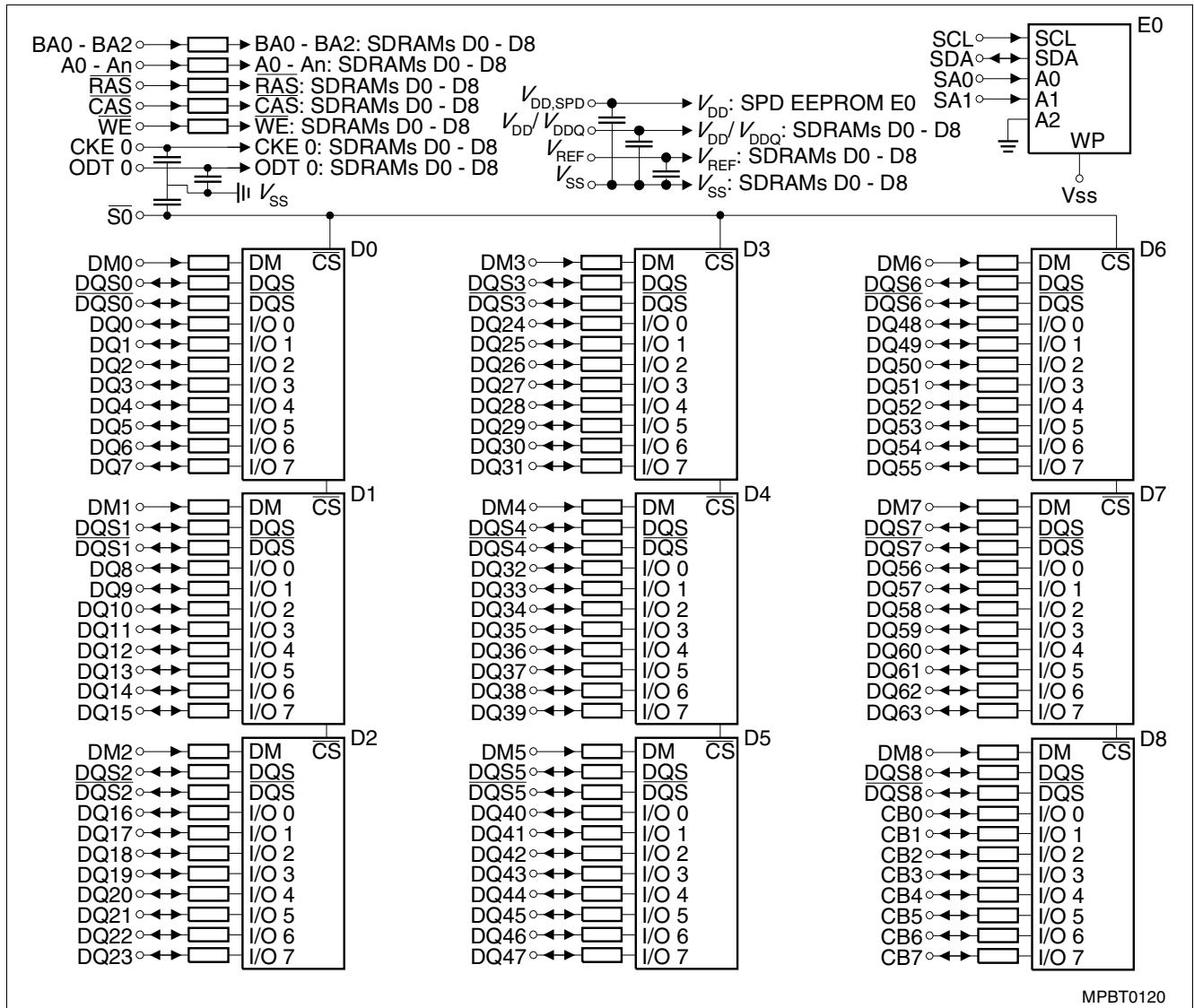
Figure 3 Block Diagram Raw Card A UDIMM (x64, 1 Rank, x8)

#### Notes

1.  $DQ, DQS, \overline{DQS}, DM$  resistors are  $22 \Omega \pm 5 \%$
2.  $BA_n, A_n, \overline{RAS}, \overline{CAS}, \overline{WE}$  resistors are  $5.1 \Omega \pm 5 \%$
3.  $ODT, CKE, \overline{S}$  capacitors are  $24 pF$
4. All  $CK$  lines have resistor termination between  $CK$  and  $\overline{CK}$ .

Table 9 Clock Signal Loads

Clock Input	SDRAMs
CK0, CK0	2
CK1, CK1	3
CK2, CK3	3



MPBT0120

Figure 4 Block Diagram Raw Card A UDIMM (x72, 1 Rank, x8)

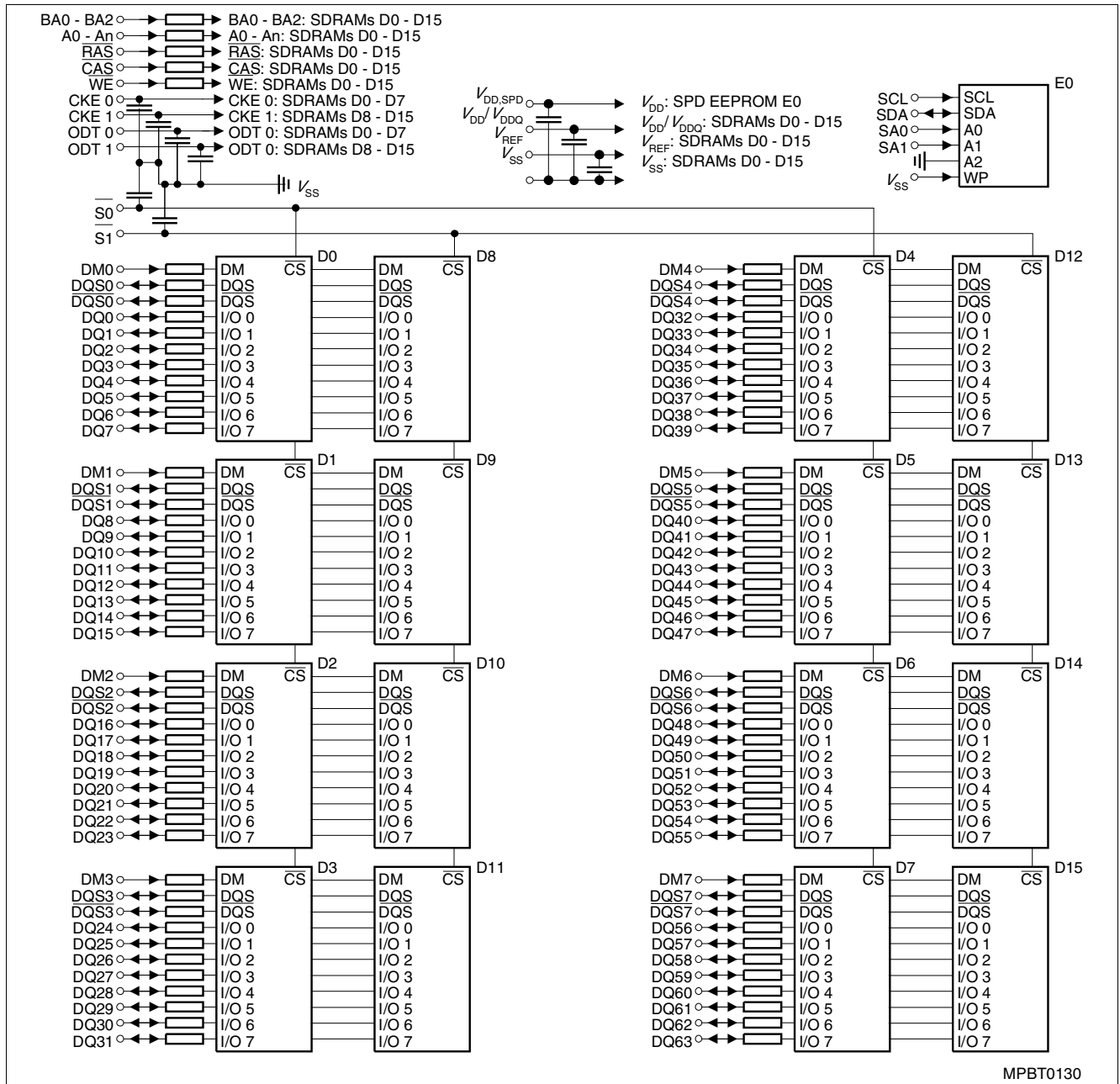
#### Notes

1.  $\overline{DQ}$ ,  $\overline{DQS}$ ,  $\overline{DM}$ ,  $\overline{CB}$  resistors are  $22\ \Omega \pm 5\%$
2.  $\overline{BA_n}$ ,  $\overline{A_n}$ ,  $\overline{RAS}$ ,  $\overline{CAS}$ ,  $\overline{WE}$  resistors are  $5.1\ \Omega \pm 5\%$
3. All  $\overline{CK}$  lines have resistor termination between  $\overline{CK}$  and  $\overline{CK}$

Table 10 Clock Signal Loads

Clock Input	SDRAMs	Note
CK0, $\overline{CK0}$	3	1)
CK1, $\overline{CK1}$	3	
CK2, $\overline{CK2}$	3	

1) 2 SDRAMs for CK0 in case of non-ECC



**Figure 5** Block Diagram Raw Card B UDIMM (x64, 2 Ranks, x8)

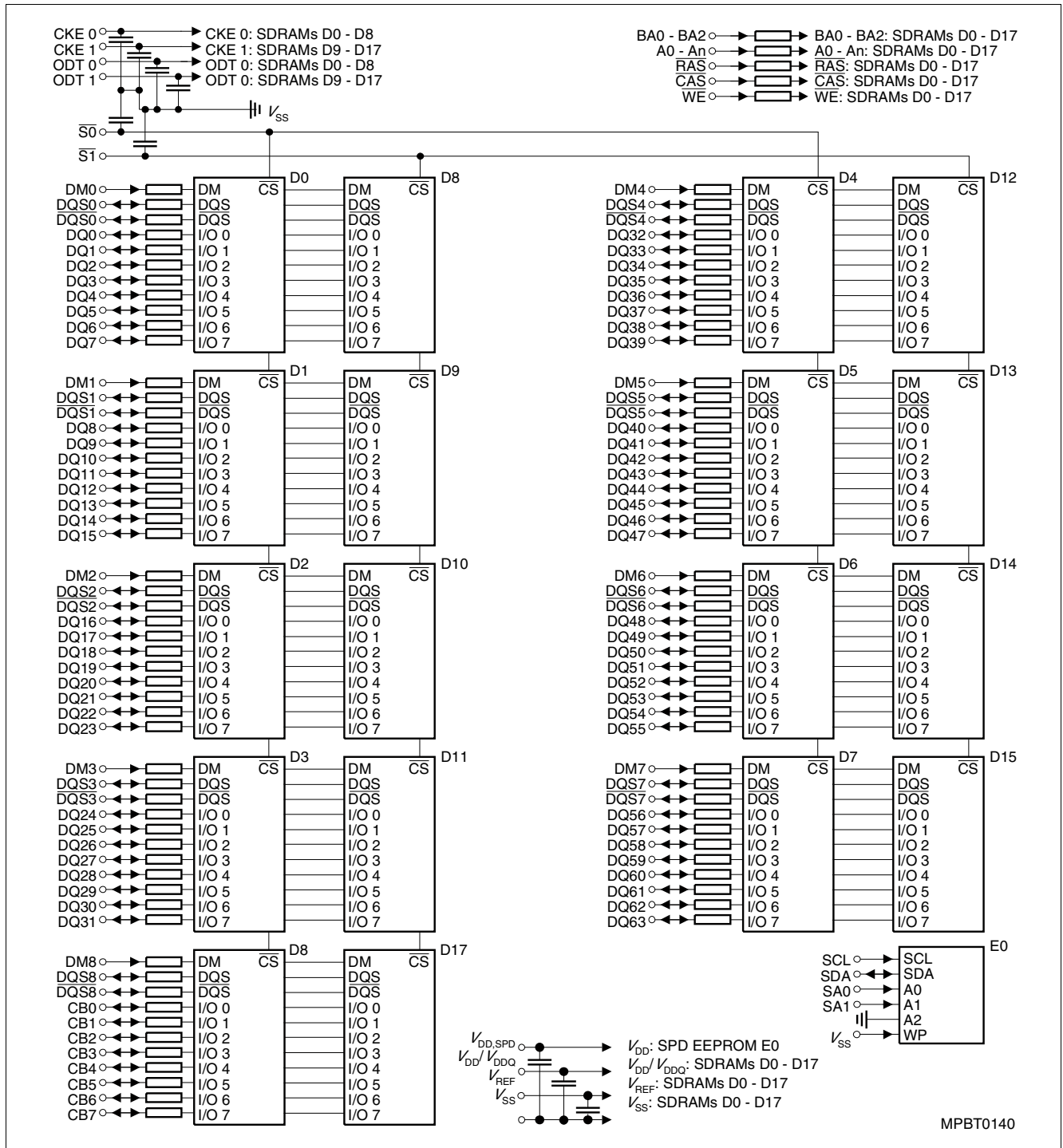
#### Notes

1.  $DQ, \overline{DQS}, \overline{DM}, \overline{CB}$  resistors are  $22 \Omega \pm 5 \%$
2.  $\overline{BA_n}, \overline{A_n}, \overline{RAS}, \overline{CAS}, \overline{WE}$  resistors are  $7.5 \Omega \pm 5 \%$
3.  $ODT, CKE, \overline{S}$  capacitors are  $24 \text{ pF}$
4. All CK lines have resistor termination between CK and  $\overline{CK}$ .

**Table 11** Clock Signal Loads

Clock Input	SDRAMs
CK0, $\overline{CK0}$	4
CK1, $\overline{CK1}$	6
CK2, $\overline{CK2}$	6

### Pin Configuration



MPBT0140

**Figure 6** Block Diagram Raw Card B UDIMM (x72, 2 Ranks, x8)

### Notes

1.  $DQ, DQS, \overline{DQS}, DM, CB$  resistors are  $22 \Omega \pm 5 \%$
2.  $BA_n, A_n, \overline{RAS}, \overline{CAS}, \overline{WE}$  resistors are  $7.5 \Omega \pm 5 \%$
3.  $ODT, CKE, \overline{S}$  capacitors are  $24 pF$
4. All  $CK$  lines have resistor termination between  $CK$  and  $\overline{CK}$ .

**Table 12** Clock Signal Loads

Clock Input	SDRAMs	Note
CK0, $\overline{CK0}$	6	
CK1, $\overline{CK1}$	6	
CK2, $\overline{CK2}$	6	



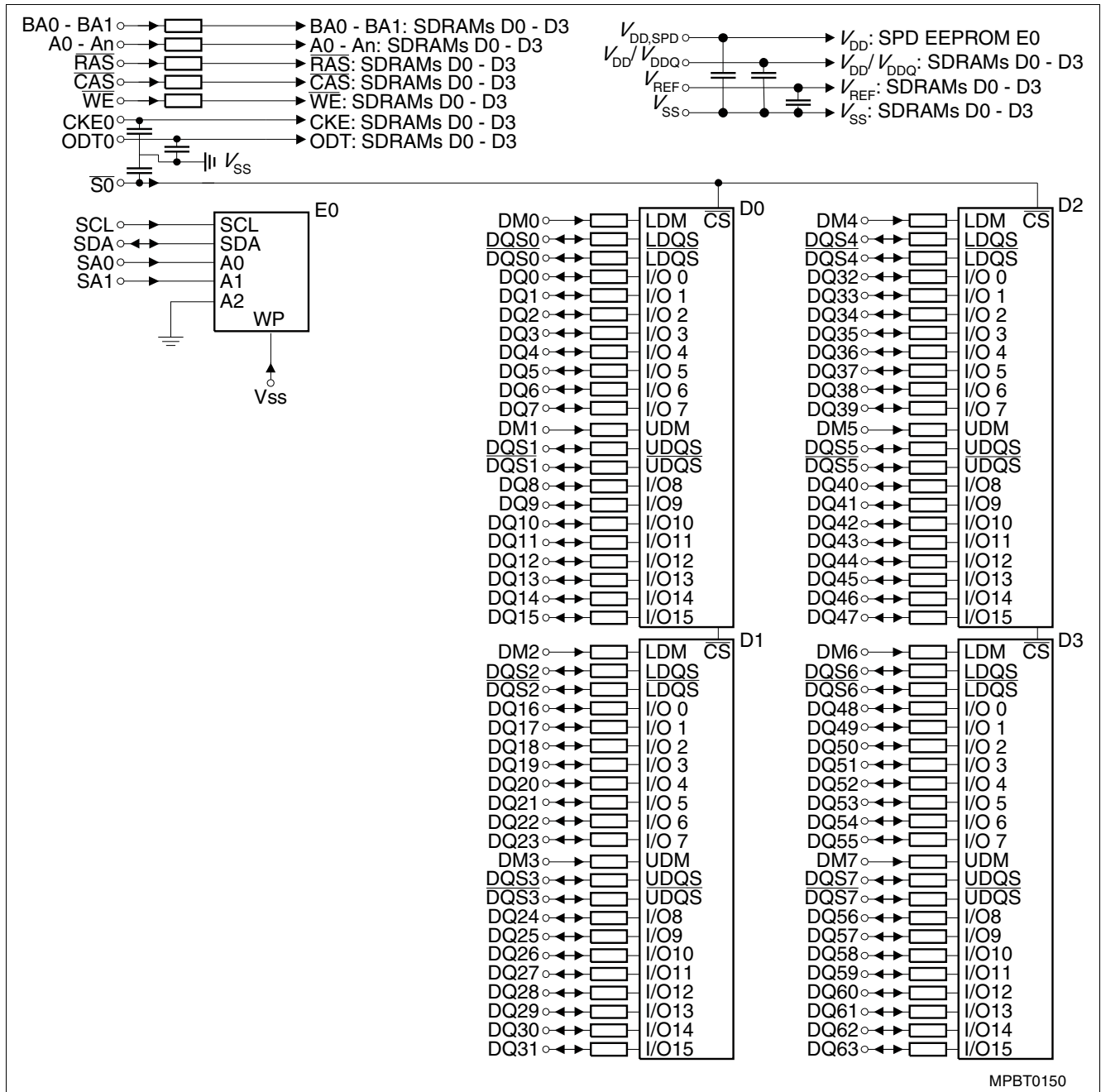


Figure 7 Block Diagram Raw Card C UDIMM (x64, 1 Rank, x16)

#### Notes

1. DQ, DQS, DM resistors are  $22 \Omega \pm 5 \%$
2. BAn, An, RAS, CAS, WE resistors are  $10 \Omega \pm 5 \%$

## Pin Configuration

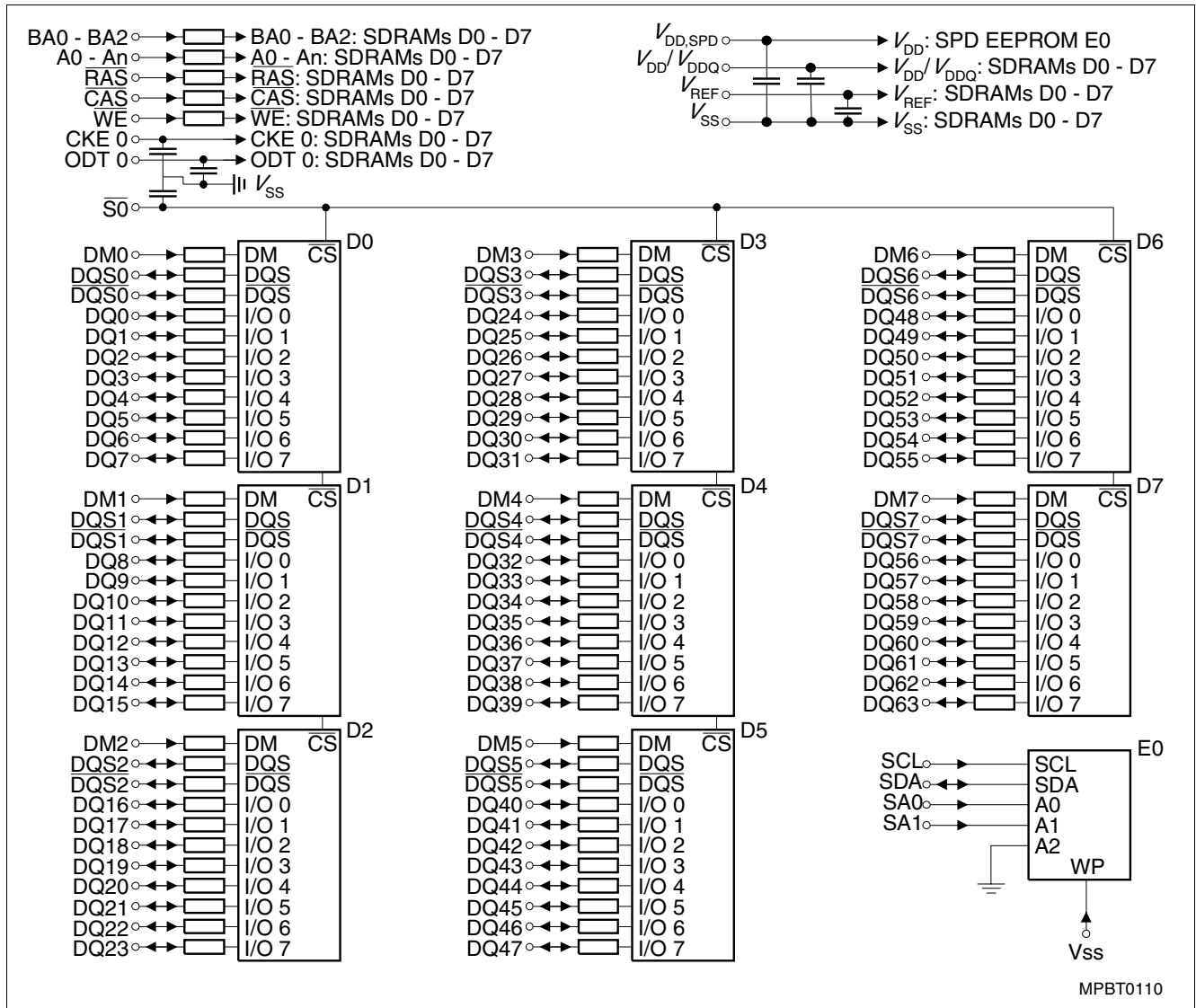


Figure 8 Block Diagram Raw Card D UDIMM (x64, 1 Rank, x8)

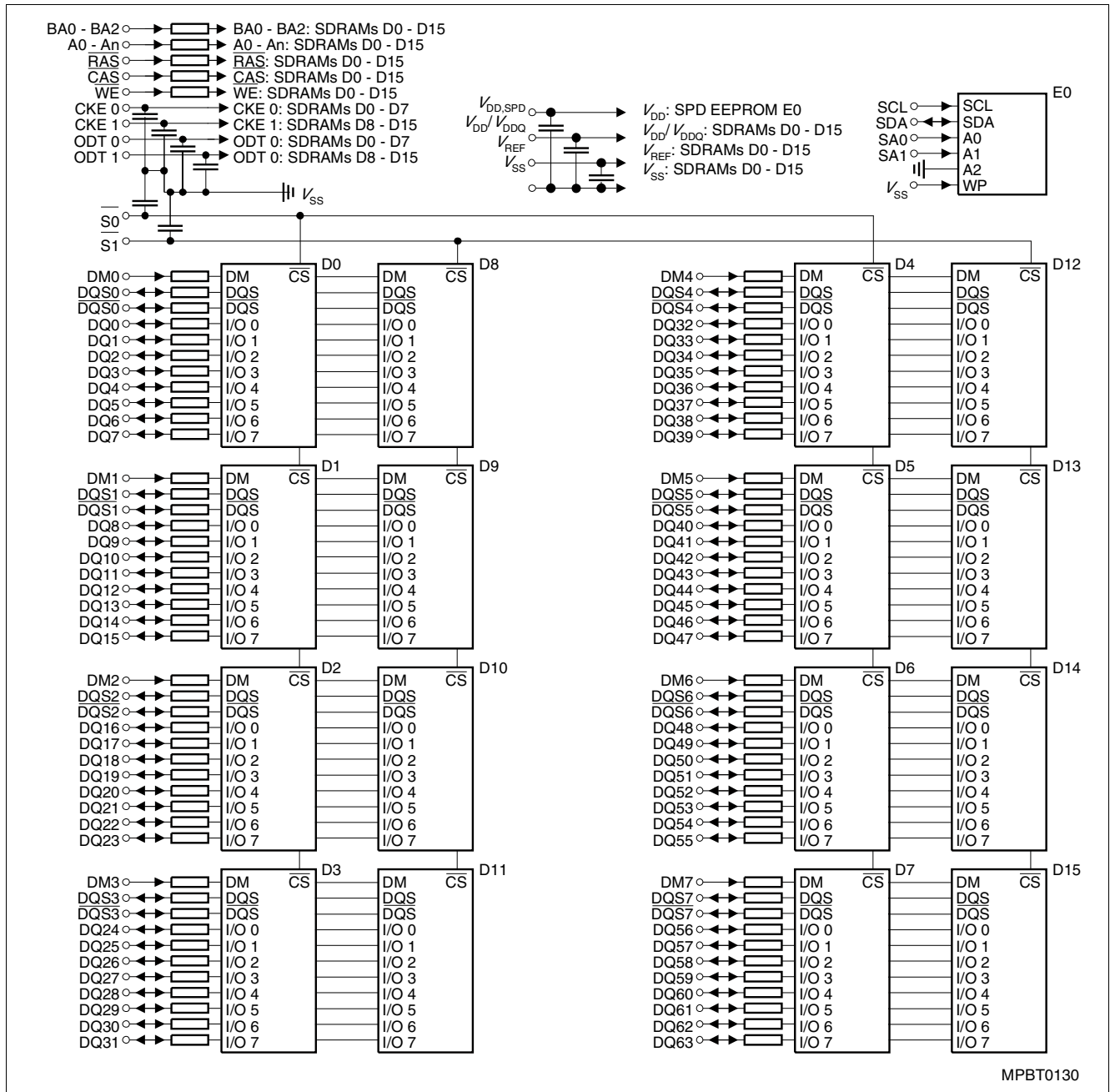
### Notes

1.  $DQ, DQS, \overline{DQS}, DM, CB$  resistors are  $22 \Omega \pm 5 \%$
2.  $BA_n, A_n, RAS, CAS, WE$  resistors are  $5.1 \Omega \pm 5 \%$
3.  $ODT, CKE, \overline{S}$  capacitors are  $24 \text{ pF}$
4. All  $CK$  lines have resistor termination between  $CK$  and  $\overline{CK}$ .

Table 13 Clock Signal Loads

Clock Input	SDRAMs	Note
CK0, $\overline{CK0}$	4	
CK1, $\overline{CK1}$	6	
CK2, $\overline{CK2}$	6	





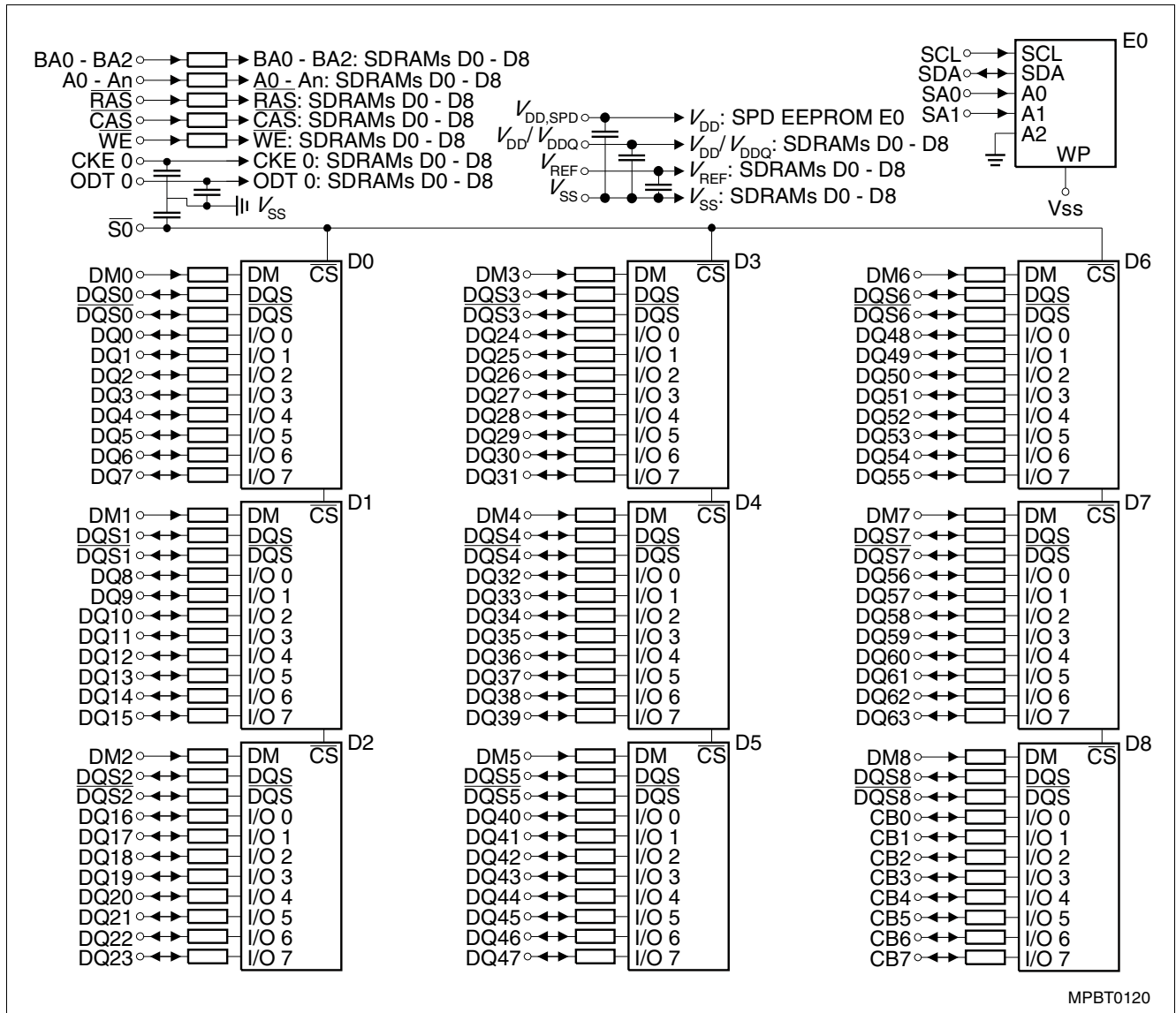
**Figure 9** Block Diagram Raw Card E UDIMM (×64, 2 Ranks, ×8)

## Notes

1.  $DQ, DQS, \overline{DQS}, DM, CB$  resistors are  $22 \Omega \pm 5 \%$
2.  $BAn, An, \overline{RAS}, \overline{CAS}, \overline{WE}$  resistors are  $5.1 \Omega \pm 5 \%$
3.  $ODT, CKE, \overline{S}$  capacitors are  $24 \text{ pF}$
4. All  $CK$  lines have resistor termination between  $CK$  and  $\overline{CK}$ .

### Table 14 Clock Signal Loads

Clock Input	SDRAMs	Note
CK0, $\overline{\text{CK0}}$	2	
CK1, $\overline{\text{CK1}}$	3	
CK2, $\overline{\text{CK2}}$	3	



MPBT0120

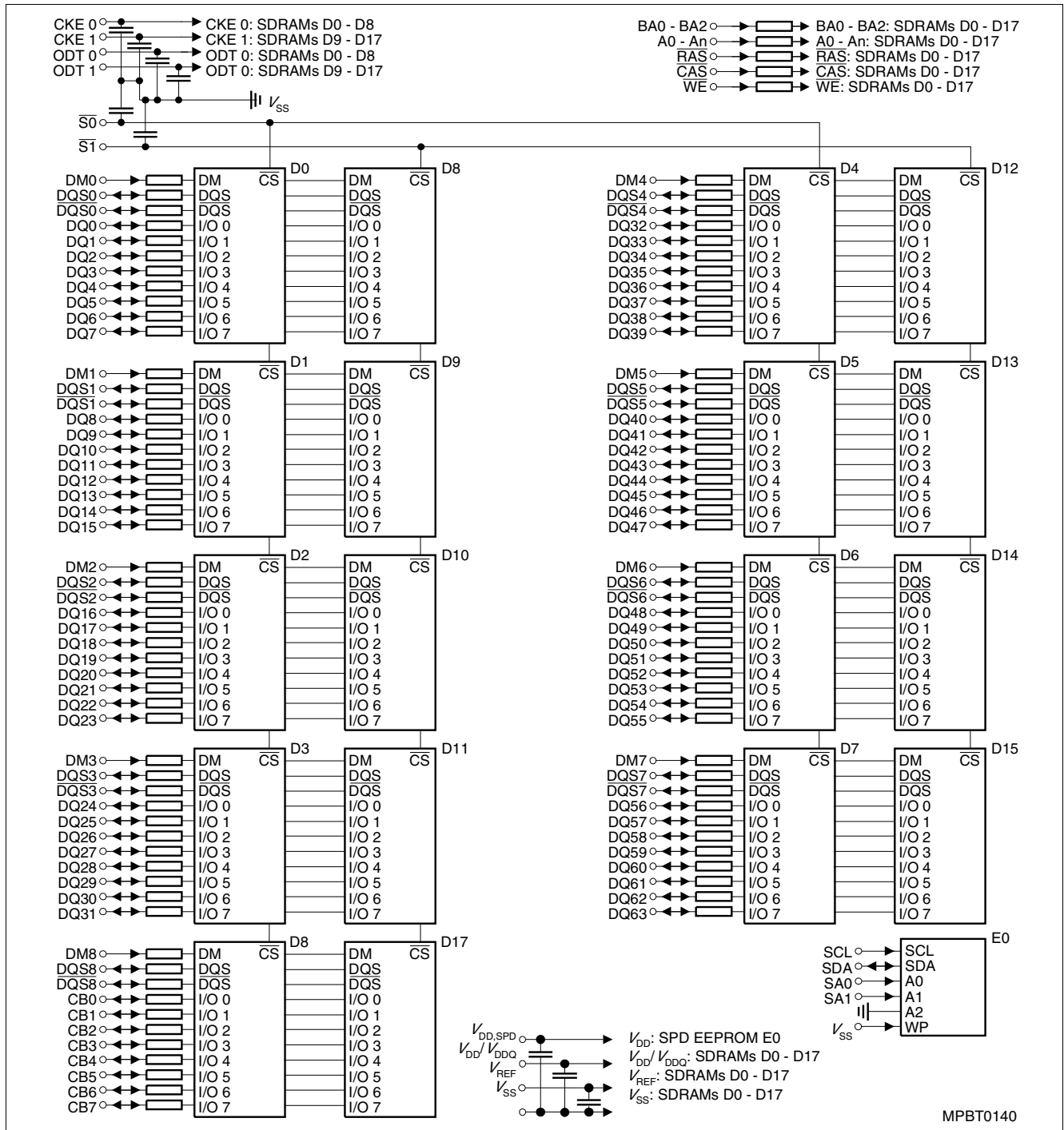
Figure 10 Block Diagram Raw Card F UDIMM (x72, 1 Rank, x8)

#### Notes

1.  $DQ, DQS, \overline{DQS}, DM$  resistors are  $22 \Omega \pm 5 \%$
2.  $BA_n, A_n, \overline{RAS}, \overline{CAS}, \overline{WE}$  resistors are  $5.1 \Omega \pm 5 \%$
3.  $ODT, \overline{CKE}, \overline{S}$  capacitors are  $24 \text{ pF}$
4. All  $CK$  lines have resistor termination between  $CK$  and  $\overline{CK}$ .

Table 15 Clock Signal Loads

Clock Input	SDRAMs	Note
$CK0, \overline{CK0}$	2	
$CK1, \overline{CK1}$	3	
$CK2, \overline{CK2}$	3	



**Figure 11** Block Diagram Raw Card G UDIMM (x72, 2 Ranks, x8)

### Notes

1. DQ, DQS,  $\overline{DQS}$ , DM resistors are  $22 \Omega \pm 5 \%$
2. BAn, An,  $\overline{RAS}$ ,  $\overline{CAS}$ ,  $\overline{WE}$  resistors are  $5.1 \Omega \pm 5 \%$
3. ODT, CKE,  $\overline{S}$  capacitors are 24 pF
4. All CK lines have resistor termination between CK and  $\overline{CK}$ .

**Table 16** Clock Signal Loads

Clock Input	SDRAMs	Note
CK0, $\overline{CK0}$	2	
CK1, $\overline{CK1}$	3	
CK2, $\overline{CK2}$	3	

## 4 Electrical Characteristics

### 4.1 Absolute Maximum Ratings

**Table 17 Absolute Maximum Ratings**

Parameter	Symbol	Values		Unit	Note/Test Condition
		Min.	Max.		
Voltage on any pins relative to $V_{SS}$	$V_{IN}, V_{OUT}$	- 0.5	2.3	V	1)
Voltage on $V_{DD}$ relative to $V_{SS}$	$V_{DD}$	- 1.0	2.3	V	1)
Voltage on $V_{DDQ}$ relative to $V_{SS}$	$V_{DDQ}$	- 0.5	2.3	V	1)
Storage Humidity (without condensation)	$H_{STG}$	5	95	%	1)

- 1) Stresses greater than those listed may cause permanent damage to the device. This is a stress rating only, and device functional operation at or above the conditions indicated is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

### 4.2 DC Operating Conditions

**Table 18 Operating Conditions**

Parameter	Symbol	Values		Unit	Note
		Min.	Max.		
Operating temperature (ambient)	$T_{OPR}$	0	+65	°C	
DRAM Case Temperature	$T_{CASE}$	0	+95	°C	1)2)3)4)
Storage Temperature	$T_{STG}$	- 50	+100	°C	
Barometric Pressure (operating & storage)	PBar	+69	+105	kPa	5)
Operating Humidity (relative)	$H_{OPR}$	10	90	%	

- 1) DRAM Component Case Temperature is the surface temperature in the center on the top side of any of the DRAMs.  
2) Within the DRAM Component Case Temperature Range all DRAM specifications will be supported  
3) Above 85 °C DRAM Case Temperature the Auto-Refresh command interval has to be reduced to  $t_{REFI} = 3.9 \mu s$   
4) Self-Refresh period is hard-coded in the DRAMs and therefore it is imperative that the system ensures the DRAM is below 85 °C Case Temperature before initiating Self-Refresh operation.  
5) Up to 3000 m.

Electrical Characteristics DC Operating Conditions

Table 19 Supply Voltage Levels and DC Operating Conditions

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Device Supply Voltage	$V_{DD}$	1.7	1.8	1.9	V	
Output Supply Voltage	$V_{DDQ}$	1.7	1.8	1.9	V	1)
Input Reference Voltage	$V_{REF}$	$0.49 \times V_{DDQ}$	$0.5 \times V_{DDQ}$	$0.51 \times V_{DDQ}$	V	2)
SPD Supply Voltage	$V_{DDSPD}$	1.7	—	3.6	V	
DC Input Logic High	$V_{IH(DC)}$	$V_{REF} + 0.125$	—	$V_{DDQ} + 0.3$	V	
DC Input Logic Low	$V_{IL(DC)}$	- 0.30	—	$V_{REF} - 0.125$	V	
In / Output Leakage Current	$I_L$	- 5	—	5	μA	3)

1) Under all conditions,  $V_{DDQ}$  must be less than or equal to  $V_{DD}$

2) Peak to peak AC noise on  $V_{REF}$  may not exceed  $\pm 2\% V_{REF(DC)}$ .  $V_{REF}$  is also expected to track noise in  $V_{DDQ}$ .

3) Input voltage for any connector pin under test of  $0\text{ V} \leq V_{IN} \leq V_{DDQ} + 0.3\text{ V}$ ; all other pins at 0 V. Current is per pin

## 4.3 AC Characteristics

### 4.3.1 Speed Grade Definitions

**Table 20 Speed Grade Definition Speed Bins for DDR2-667**

Speed Grade			DDR2-667		DDR2-667		Unit	Note
IFX Sort Name			-3		-3S			
CAS-RCD-RP latencies			4-4-4		5-5-5		$t_{\text{CK}}$	
Parameter		Symbol	Min.	Max.	Min.	Max.	—	
Clock Frequency	@ CL = 3	$t_{\text{CK}}$	5	8	5	8	ns	1)2)3)4)
	@ CL = 4	$t_{\text{CK}}$	3	8	3.75	8	ns	1)2)3)4)
	@ CL = 5	$t_{\text{CK}}$	3	8	3	8	ns	1)2)3)4)
Row Active Time		$t_{\text{RAS}}$	45	70000	45	70000	ns	1)2)3)4)5)
Row Cycle Time		$t_{\text{RC}}$	57	—	60	—	ns	1)2)3)4)
RAS-CAS-Delay		$t_{\text{RCD}}$	12	—	15	—	ns	1)2)3)4)
Row Precharge Time		$t_{\text{RP}}$	12	—	15	—	ns	1)2)3)4)

- 1) Timings are guaranteed with CK/CK differential Slew Rate of 2.0 V/ns. For DQS signals timings are guaranteed with a differential Slew Rate of 2.0 V/ns in differential strobe mode and a Slew Rate of 1 V/ns in single ended mode. Timings are further guaranteed for normal OCD drive strength (EMRS(1) A1 = 0) only.
- 2) The CK/CK input reference level (for timing reference to CK/CK) is the point at which CK and CK cross. The DQS/DQS, RDQS/RDQS, input reference level is the crosspoint when in differential strobe mode
- 3) Inputs are not recognized as valid until  $V_{REF}$  stabilizes. During the period before  $V_{REF}$  stabilizes,  $CKE = 0.2 \times V_{DDQ}$  is recognized as low.
- 4) The output timing reference voltage level is  $V_{TT}$ .
- 5)  $t_{RAS,MAX}$  is calculated from the maximum amount of time a DDR2 device can operate without a refresh command which is equal to  $9 \times t_{REFI}$ .

**Table 21 Speed Grade Definition Speed Bins for DDR2-533C and DDR2-400B**

Speed Grade			DDR2-533		DDR2-400		Unit	Note
IFX Sort Name			-3.7		-5			
CAS-RCD-RP latencies			4-4-4		3-3-3		$t_{\text{CK}}$	
Parameter		Symbol	Min.	Max.	Min.	Max.	—	
Clock Frequency	@ CL = 3	$t_{\text{CK}}$	5	8	5	8	ns	1)2)3)4)
	@ CL = 4	$t_{\text{CK}}$	3.75	8	5	8	ns	1)2)3)4)
	@ CL = 5	$t_{\text{CK}}$	3.75	8	5	8	ns	1)2)3)4)
Row Active Time		$t_{\text{RAS}}$	45	70000	40	70000	ns	1)2)3)4)5)
Row Cycle Time		$t_{\text{RC}}$	60	—	55	—	ns	1)2)3)4)
RAS-CAS-Delay		$t_{\text{RCD}}$	15	—	15	—	ns	1)2)3)4)
Row Precharge Time		$t_{\text{RP}}$	15	—	15	—	ns	1)2)3)4)

- 1) Timings are guaranteed with CK/CK differential Slew Rate of 2.0 V/ns. For DQS signals timings are guaranteed with a differential Slew Rate of 2.0 V/ns in differential strobe mode and a Slew Rate of 1 V/ns in single ended mode. Timings are further guaranteed for normal OCD drive strength (EMRS(1) A1 = 0) only.
- 2) The CK/CK input reference level (for timing reference to CK/CK) is the point at which CK and CK cross. The DQS / DQS, RDQS / RDQS, input reference level is the crosspoint when in differential strobe mode

Electrical Characteristics AC Characteristics

- 3) Inputs are not recognized as valid until  $V_{REF}$  stabilizes. During the period before  $V_{REF}$  stabilizes,  $CKE = 0.2 \times V_{DDQ}$  is recognized as low.
- 4) The output timing reference voltage level is  $V_{TT}$ .
- 5)  $t_{RAS,MAX}$  is calculated from the maximum amount of time a DDR2 device can operate without a refresh command which is equal to  $9 \times t_{REFI}$ .

### 4.3.2 AC Timing Parameters

Table 22 Timing Parameter by Speed Grade - DDR2-667

Parameter	Symbol	DDR2-667		Unit	Note 1)2)3)4)5)6) 7)
		Min.	Max.		
DQ output access time from CK / $\overline{CK}$	$t_{AC}$	-450	+450	ps	
CAS A to CAS B command period	$t_{CCD}$	2	—	$t_{CK}$	
CK, $\overline{CK}$ high-level width	$t_{CH}$	0.45	0.55	$t_{CK}$	
CKE minimum high and low pulse width	$t_{CKE}$	3	—	$t_{CK}$	
CK, $\overline{CK}$ low-level width	$t_{CL}$	0.45	0.55	$t_{CK}$	
Auto-Precharge write recovery + precharge time	$t_{DAL}$	$WR + t_{RP}$	—	$t_{CK}$	
Minimum time clocks remain ON after CKE asynchronously drops LOW	$t_{DELAY}$	$t_{IS} + t_{CK} + t_{IH}$	—	ns	
DQ and DM input hold time (differential data strobe)	$t_{DH}(\text{base})$	175	—	ps	
DQ and DM input hold time (single ended data strobe)	$t_{DH1}(\text{base})$	-25	—	ps	
DQ and DM input pulse width (each input)	$t_{DIPW}$	0.35	—	$t_{CK}$	
DQS output access time from CK / $\overline{CK}$	$t_{DQSCK}$	-400	+400	ps	
DQS input low (high) pulse width (write cycle)	$t_{DQSL,H}$	0.35	—	$t_{CK}$	
DQS-DQ skew (for DQS & associated DQ signals)	$t_{DQSQ}$	240	—	ps	
Write command to 1st DQS latching transition	$t_{DQSS}$	-0.25	+0.25	$t_{CK}$	
DQ and DM input setup time (differential data strobe)	$t_{DS}(\text{base})$	100	—	ps	
DQ and DM input setup time (single ended data strobe)	$t_{DS1}(\text{base})$	-25	—	ps	
DQS falling edge hold time from CK (write cycle)	$t_{DSH}$	0.2	—	$t_{CK}$	
DQS falling edge to CK setup time (write cycle)	$t_{DSS}$	0.2	—	$t_{CK}$	
Clock half period	$t_{HP}$	MIN. ( $t_{CL}$ , $t_{CH}$ )			
Data-out high-impedance time from CK / $\overline{CK}$	$t_{HZ}$	—	$t_{AC,MAX}$	ps	
Address and control input hold time	$t_{IH}(\text{base})$	275	—	ps	
Address and control input pulse width (each input)	$t_{IPW}$	0.6	—	$t_{CK}$	
Address and control input setup time	$t_{IS}(\text{base})$	200	—	ps	
DQ low-impedance time from CK / $\overline{CK}$	$t_{LZ(DQ)}$	$2 \times t_{AC,MIN}$	$t_{AC,MAX}$	ps	
DQS low-impedance from CK / $\overline{CK}$	$t_{LZ(DQS)}$	$t_{AC,MIN}$	$t_{AC,MAX}$	ps	
Mode register set command cycle time	$t_{MRD}$	2	—	$t_{CK}$	
OCD drive mode output delay	$t_{OIT}$	0	12	ns	
Data output hold time from DQS	$t_{QH}$	$t_{HP} - t_{QHS}$	—		
Data hold skew factor	$t_{QHS}$	340	—	ps	

Table 22 Timing Parameter by Speed Grade - DDR2-667

Parameter	Symbol	DDR2-667		Unit	Note 1)2)3)4)5)6) 7)
		Min.	Max.		
Average periodic refresh Interval	$t_{REFI}$	—	7.8	$\mu s$	8)
		—	3.9	$\mu s$	9)
Auto-Refresh to Active/Auto-Refresh command period	$t_{RFC}$	105	—	ns	
Read preamble	$t_{RPRE}$	0.9	1.1	$t_{CK}$	
Read postamble	$t_{RPST}$	0.40	0.60	$t_{CK}$	
Active bank A to Active bank B command period	$t_{RRD}$	7.5	—	ns	10)
		10	—	ns	11)
Internal Read to Precharge command delay	$t_{RTP}$	7.5	—	ns	
Write preamble	$t_{WPRE}$	0.35	—	$t_{CK}$	
Write postamble	$t_{WPST}$	0.40	0.60	$t_{CK}$	
Write recovery time for write without Auto-Precharge	$t_{WR}$	15	—	ns	
Write recovery time for write with Auto-Precharge	WR	$t_{WR}/t_{CK}$		$t_{CK}$	
Internal Write to Read command delay	$t_{WTR}$	7.5	—	ns	
Exit power down to any valid command (other than NOP or Deselect)	$t_{XARD}$	2	—	$t_{CK}$	
Exit active power-down mode to Read command (slow exit, lower power)	$t_{XARDS}$	7 – AL	—	$t_{CK}$	
Exit precharge power-down to any valid command (other than NOP or Deselect)	$t_{XP}$	2	—	$t_{CK}$	
Exit Self-Refresh to non-Read command	$t_{XSNR}$	$t_{RFC} + 10$	—	ns	
Exit Self-Refresh to Read command	$t_{XSRD}$	200	—	$t_{CK}$	

1) For details and notes see the relevant INFINEON component data sheet

2)  $V_{DDQ} = 1.8 V \pm 0.1 V$ ;  $V_{DD} = 1.8 V \pm 0.1 V$ . See notes 4)5)6)7)

3) Timing that is not specified is illegal and after such an event, in order to guarantee proper operation, the DRAM must be powered down and then restarted through the specified initialization sequence before normal operation can continue.

4) Timings are guaranteed with CK/ $\overline{CK}$  differential Slew Rate of 2.0 V/ns. For DQS signals timings are guaranteed with a differential Slew Rate of 2.0 V/ns in differential strobe mode and a Slew Rate of 1 V/ns in single ended mode.

5) The CK/ $\overline{CK}$  input reference level (for timing reference to CK/ $\overline{CK}$ ) is the point at which CK and  $\overline{CK}$  cross. The DQS/ $\overline{DQS}$ , RDQS/ $\overline{RDQS}$ , input reference level is the crosspoint when in differential strobe mode

6) Inputs are not recognized as valid until  $V_{REF}$  stabilizes. During the period before  $V_{REF}$  stabilizes, CKE =  $0.2 \times V_{DDQ}$  is recognized as low.

7) The output timing reference voltage level is  $V_{TT}$ .

8)  $0 \leq T_{CASE} \leq 85^\circ C$

9)  $85^\circ C < T_{CASE} \leq 95^\circ C$

10) x4 & x8

11) x16



Electrical Characteristics AC Characteristics

Table 23 Timing Parameter by Speed Grade - DDR2-400 & DDR2-533

Parameter	Symbol	DDR2-533		DDR2-400		Unit	Note 1)2)3)4)5) 6)7)
		Min.	Max.	Min.	Max.		
DQ output access time from CK/CK	$t_{AC}$	-500	+500	-600	+600	ps	
CAS A to CAS B command period	$t_{CCD}$	2	—	2	—	$t_{CK}$	
CK,CK high-level width	$t_{CH}$	0.45	0.55	0.45	0.55	$t_{CK}$	
CKE minimum high and low pulse width	$t_{CKE}$	3	—	3	—	$t_{CK}$	
CK,CK low-level width	$t_{CL}$	0.45	0.55	0.45	0.55	$t_{CK}$	
Auto-Precharge write recovery + precharge time	$t_{DAL}$	WR + $t_{RP}$	—	WR + $t_{RP}$	—	$t_{CK}$	
Minimum time clocks remain ON after CKE asynchronously drops LOW	$t_{DELAY}$	$t_{IS} + t_{CK} + t_{IH}$	—	$t_{IS} + t_{CK} + t_{IH}$	—	ns	
DQ and DM input hold time (differential data strobe)	$t_{DH}(\text{base})$	225	—	275	—	ps	
DQ and DM input hold time (single ended data strobe)	$t_{DH1}(\text{base})$	-25	—	25	—	ps	
DQ and DM input pulse width (each input)	$t_{DIPW}$	0.35	—	0.35	—	$t_{CK}$	
DQS output access time from CK/CK	$t_{DQSCK}$	-450	+450	-500	+500	ps	
DQS input low (high) pulse width (write cycle)	$t_{DQSL,H}$	0.35	—	0.35	—	$t_{CK}$	
DQS-DQ skew (for DQS & associated DQ signals)	$t_{DQSQ}$	—	300	—	350	ps	
Write command to 1st DQS latching transition	$t_{DQSS}$	WL - 0.25	WL + 0.25	WL - 0.25	WL + 0.25	$t_{CK}$	
DQ and DM input setup time (differential data strobe)	$t_{DS}(\text{base})$	100	—	150	—	ps	
DQ and DM input setup time (single ended data strobe)	$t_{DS1}(\text{base})$	-25	—	25	—	ps	
DQS falling edge hold time from CK (write cycle)	$t_{DSH}$	0.2	—	0.2	—	$t_{CK}$	
DQS falling edge to CK setup time (write cycle)	$t_{DSS}$	0.2	—	0.2	—	$t_{CK}$	
Clock half period	$t_{HP}$	MIN. ( $t_{CL}$ , $t_{CH}$ )		MIN. ( $t_{CL}$ , $t_{CH}$ )			
Data-out high-impedance time from CK/CK	$t_{HZ}$	—	$t_{AC,MAX}$	—	$t_{AC,MAX}$	ps	
Address and control input hold time	$t_{IH}(\text{base})$	375	—	475	—	ps	
Address and control input pulse width (each input)	$t_{IPW}$	0.6	—	0.6	—	$t_{CK}$	
Address and control input setup time	$t_{IS}(\text{base})$	250	—	350	—	ps	

Electrical Characteristics AC Characteristics

Table 23 Timing Parameter by Speed Grade - DDR2-400 & DDR2-533 (cont'd)

Parameter	Symbol	DDR2-533		DDR2-400		Unit	Note 1)2)3)4)5) 6)7)
		Min.	Max.	Min.	Max.		
DQ low-impedance time from CK / $\overline{\text{CK}}$	$t_{\text{LZ(DQ)}}$	$2 \times t_{\text{AC.MIN}}$	$t_{\text{AC.MAX}}$	$2 \times t_{\text{AC.MIN}}$	$t_{\text{AC.MAX}}$	ps	
DQS low-impedance from CK / $\overline{\text{CK}}$	$t_{\text{LZ(DQS)}}$	$t_{\text{AC.MIN}}$	$t_{\text{AC.MAX}}$	$t_{\text{AC.MIN}}$	$t_{\text{AC.MAX}}$	ps	
Mode register set command cycle time	$t_{\text{MRD}}$	2	—	2	—	$t_{\text{CK}}$	
OCD drive mode output delay	$t_{\text{OIT}}$	0	12	0	12	ns	
Data output hold time from DQS	$t_{\text{QH}}$	$t_{\text{HP}} - t_{\text{QHS}}$	—	$t_{\text{HPQ}} - t_{\text{QHS}}$	—		
Data hold skew factor	$t_{\text{QHS}}$	—	400	—	450	ps	
Average periodic refresh Interval	$t_{\text{REFI}}$	—	7.8	—	7.8	$\mu\text{s}$	8)
		—	3.9	—	3.9	$\mu\text{s}$	9)
Auto-Refresh to Active/Auto-Refresh command period	$t_{\text{RFC}}$	105	—	105	—	ns	
Read preamble	$t_{\text{RPRE}}$	0.9	1.1	0.9	1.1	$t_{\text{CK}}$	
Read postamble	$t_{\text{RPST}}$	0.40	0.60	0.40	0.60	$t_{\text{CK}}$	
Active bank A to Active bank B command period	$t_{\text{RRD}}$	7.5	—	7.5	—	ns	10)
		10	—	10	—	ns	11)
Internal Read to Precharge command delay	$t_{\text{RTP}}$	7.5	—	7.5	—	ns	
Write preamble	$t_{\text{WPRE}}$	$0.35 \times t_{\text{CK}}$	—	$0.35 \times t_{\text{CK}}$	—	$t_{\text{CK}}$	
Write postamble	$t_{\text{WPST}}$	0.40	0.60	0.40	0.60	$t_{\text{CK}}$	
Write recovery time for write without Auto-Precharge	$t_{\text{WR}}$	15	—	15	—	ns	
Write recovery time for write with Auto-Precharge	WR	$t_{\text{WR}}/t_{\text{CK}}$		$t_{\text{WR}}/t_{\text{CK}}$		$t_{\text{CK}}$	
Internal Write to Read command delay	$t_{\text{WTR}}$	7.5	—	10	—	ns	
Exit power down to any valid command (other than NOP or Deselect)	$t_{\text{XARD}}$	2	—	2	—	$t_{\text{CK}}$	
Exit active power-down mode to Read command (slow exit, lower power)	$t_{\text{XARDS}}$	6 – AL	—	6 – AL	—	$t_{\text{CK}}$	
Exit precharge power-down to any valid command (other than NOP or Deselect)	$t_{\text{XP}}$	2	—	2	—	$t_{\text{CK}}$	
Exit Self-Refresh to non-Read command	$t_{\text{XSNR}}$	$t_{\text{RFC}} + 10$	—	$t_{\text{RFC}} + 10$	—	ns	
Exit Self-Refresh to Read command	$t_{\text{XSRD}}$	200	—	200	—	$t_{\text{CK}}$	

1) For details and notes see the relevant INFINEON component data sheet

2)  $V_{\text{DDQ}} = 1.8 \text{ V} \pm 0.1 \text{ V}$ ;  $V_{\text{DD}} = 1.8 \text{ V} \pm 0.1 \text{ V}$ . See notes 4)5)6)7)

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Electrical Characteristics AC Characteristics

- 3) Timing that is not specified is illegal and after such an event, in order to guarantee proper operation, the DRAM must be powered down and then restarted through the specified initialization sequence before normal operation can continue.
- 4) Timings are guaranteed with  $CK/\overline{CK}$  differential Slew Rate of 2.0 V/ns. For DQS signals timings are guaranteed with a differential Slew Rate of 2.0 V/ns in differential strobe mode and a Slew Rate of 1 V/ns in single ended mode.
- 5) The  $CK/\overline{CK}$  input reference level (for timing reference to  $CK/\overline{CK}$ ) is the point at which CK and  $\overline{CK}$  cross. The  $DQS/\overline{DQS}$ ,  $RDQS/\overline{RDQS}$ , input reference level is the crosspoint when in differential strobe mode
- 6) Inputs are not recognized as valid until  $V_{REF}$  stabilizes. During the period before  $V_{REF}$  stabilizes,  $CKE = 0.2 \times V_{DDQ}$  is recognized as low.
- 7) The output timing reference voltage level is  $V_{TT}$ .
- 8)  $0 \leq T_{CASE} \leq 85\text{ }^{\circ}\text{C}$
- 9)  $85\text{ }^{\circ}\text{C} < T_{CASE} \leq 95\text{ }^{\circ}\text{C}$
- 10) x4 & x8
- 11) x16

### 4.3.3 ODT AC Electrical Characteristics

**Table 24 ODT AC Electrical Characteristics and Operating Conditions for DDR2-667**

Symbol	Parameter / Condition	Values		Unit	Note
		Min.	Max.		
$t_{AOND}$	ODT turn-on delay	2	2	$t_{CK}$	
$t_{AON}$	ODT turn-on	$t_{AC.MIN}$	$t_{AC.MAX} + 0.7 \text{ ns}$	ns	1)
$t_{AONPD}$	ODT turn-on (Power-Down Modes)	$t_{AC.MIN} + 2 \text{ ns}$	$2 t_{CK} + t_{AC.MAX} + 1 \text{ ns}$	ns	
$t_{AOFD}$	ODT turn-off delay	2.5	2.5	$t_{CK}$	
$t_{AOF}$	ODT turn-off	$t_{AC.MIN}$	$t_{AC.MAX} + 0.6 \text{ ns}$	ns	2)
$t_{AOFPD}$	ODT turn-off (Power-Down Modes)	$t_{AC.MIN} + 2 \text{ ns}$	$2.5 t_{CK} + t_{AC.MAX} + 1 \text{ ns}$	ns	
$t_{ANPD}$	ODT to Power Down Mode Entry Latency	3	—	$t_{CK}$	
$t_{AXPD}$	ODT Power Down Exit Latency	8	—	$t_{CK}$	

1) ODT turn on time min. is when the device leaves high impedance and ODT resistance begins to turn on. ODT turn on time max is when the ODT resistance is fully on. Both are measure from  $t_{AOND}$ .

2) ODT turn off time min. is when the device starts to turn off ODT resistance. ODT turn off time max is when the bus is in high impedance. Both are measured from  $t_{AOFD}$ .

**Table 25 ODT AC Characteristics and Operating Conditions for DDR2-533 and DDR2-400**

Symbol	Parameter / Condition	Values		Unit	Note
		Min.	Max.		
$t_{AOND}$	ODT turn-on delay	2	2	$t_{CK}$	
$t_{AON}$	ODT turn-on	$t_{AC.MIN}$	$t_{AC.MAX} + 1 \text{ ns}$	ns	1)
$t_{AONPD}$	ODT turn-on (Power-Down Modes)	$t_{AC.MIN} + 2 \text{ ns}$	$2 t_{CK} + t_{AC.MAX} + 1 \text{ ns}$	ns	
$t_{AOFD}$	ODT turn-off delay	2.5	2.5	$t_{CK}$	
$t_{AOF}$	ODT turn-off	$t_{AC.MIN}$	$t_{AC.MAX} + 0.6 \text{ ns}$	ns	2)
$t_{AOFPD}$	ODT turn-off (Power-Down Modes)	$t_{AC.MIN} + 2 \text{ ns}$	$2.5 t_{CK} + t_{AC.MAX} + 1 \text{ ns}$	ns	
$t_{ANPD}$	ODT to Power Down Mode Entry Latency	3	—	$t_{CK}$	
$t_{AXPD}$	ODT Power Down Exit Latency	8	—	$t_{CK}$	

1) ODT turn on time min. is when the device leaves high impedance and ODT resistance begins to turn on. ODT turn on time max is when the ODT resistance is fully on. Both are measure from  $t_{AOND}$ .

2) ODT turn off time min. is when the device starts to turn off ODT resistance. ODT turn off time max is when the bus is in high impedance. Both are measured from  $t_{AOFD}$ .

## 4.4 Currents Specifications and Conditions

**Table 26**  $I_{DD}$  Measurement Conditions <sup>1)2)3)4)5)6)</sup>

Parameter	Symbol
<b>Operating Current 0</b> One bank Active - Precharge; $t_{CK} = t_{CK.MIN}$ , $t_{RC} = t_{RC.MIN}$ , $t_{RAS} = t_{RAS.MIN}$ , CKE is HIGH, $\overline{CS}$ is HIGH between valid commands. Address and control inputs are SWITCHING, Databus inputs are SWITCHING.	$I_{DD0}$
<b>Operating Current 1</b> One bank Active - Read - Precharge; $I_{OUT} = 0$ mA, BL = 4, $t_{CK} = t_{CK.MIN}$ , $t_{RC} = t_{RC.MIN}$ , $t_{RAS} = t_{RAS.MIN}$ , $t_{RCD} = t_{RCD.MIN}$ , AL = 0, CL = CL <sub>MIN</sub> ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands. Address and control inputs are SWITCHING, Databus inputs are SWITCHING.	$I_{DD1}$
<b>Precharge Standby Current</b> All banks idle; $\overline{CS}$ is HIGH; CKE is HIGH; $t_{CK} = t_{CK.MIN}$ ; Other control and address inputs are SWITCHING, Data bus inputs are SWITCHING.	$I_{DD2N}$
<b>Precharge Power-Down Current</b> Other control and address inputs are STABLE, Data bus inputs are FLOATING.	$I_{DD2P}$
<b>Precharge Quiet Standby Current</b> All banks idle; $\overline{CS}$ is HIGH; CKE is HIGH; $t_{CK} = t_{CK.MIN}$ ; Other control and address inputs are STABLE, Data bus inputs are FLOATING.	$I_{DD2Q}$
<b>Active Standby Current</b> Burst Read: All banks open; Continuous burst reads; BL = 4; AL = 0, CL = CL <sub>MIN</sub> ; $t_{CK} = t_{CK.MIN}$ ; $t_{RAS} = t_{RAS.MAX}$ , $t_{RP} = t_{RP.MIN}$ ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands. Address inputs are SWITCHING; Data Bus inputs are SWITCHING; $I_{OUT} = 0$ mA.	$I_{DD3N}$
<b>Active Power-Down Current</b> All banks open; $t_{CK} = t_{CK.MIN}$ , CKE is LOW; Other control and address inputs are STABLE, Data bus inputs are FLOATING. MRS A12 bit is set to LOW (Fast Power-down Exit);	$I_{DD3P(0)}$
<b>Active Power-Down Current</b> All banks open; $t_{CK} = t_{CK.MIN}$ , CKE is LOW; Other control and address inputs are STABLE, Data bus inputs are FLOATING. MRS A12 bit is set to HIGH (Slow Power-down Exit);	$I_{DD3P(1)}$
<b>Operating Current</b> Burst Write: All banks open; Continuous burst writes; BL = 4; AL = 0, CL = CL <sub>MIN</sub> ; $t_{CK} = t_{CK.MIN}$ ; $t_{RAS} = t_{RAS.MAX}$ , $t_{RP} = t_{RP.MAX}$ ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands. Address inputs are SWITCHING; Data Bus inputs are SWITCHING;	$I_{DD4W}$
<b>Burst Refresh Current</b> $t_{CK} = t_{CK.MIN}$ , Refresh command every $t_{RFC} = t_{RFC.MIN}$ interval, CKE is HIGH, $\overline{CS}$ is HIGH between valid commands, Other control and address inputs are SWITCHING, Data bus inputs are SWITCHING.	$I_{DD5B}$
<b>Distributed Refresh Current</b> $t_{CK} = t_{CK.MIN}$ , Refresh command every $t_{RFC} = t_{REFI}$ interval, CKE is LOW and $\overline{CS}$ is HIGH between valid commands, Other control and address inputs are SWITCHING, Data bus inputs are SWITCHING.	$I_{DD5D}$
<b>Self-Refresh Current</b> CKE $\leq 0.2$ V; external clock off, CK and $\overline{CK}$ at 0 V; Other control and address inputs are FLOATING, Data bus inputs are FLOATING. $I_{DD6}$ current values are guaranteed up to $T_{CASE}$ of 85 °C max.	$I_{DD6}$
<b>All Bank Interleave Read Current</b> All banks are being interleaved at minimum $t_{RC}$ without violating $t_{RRD}$ using a burst length of 4. Control and address bus inputs are STABLE during DESELECTS. $I_{out} = 0$ mA.	$I_{DD7}$

1)  $V_{DDQ} = 1.8 \text{ V} \pm 0.1 \text{ V}$ ;  $V_{DD} = 1.8 \text{ V} \pm 0.1 \text{ V}$

Electrical Characteristics Currents Specifications and Conditions

- 2)  $I_{DD}$  specifications are tested after the device is properly initialized and  $I_{DD}$  parameter are specified with ODT disabled.
- 3) Definitions for  $I_{DD}$  see [Table 27](#)
- 4)  $I_{DD1}$ ,  $I_{DD4R}$  and  $I_{DD7}$  current measurements are defined with the outputs disabled ( $I_{OUT} = 0$  mA). To achieve this on module level the output buffers can be disabled using an EMRS(1) (Extended Mode Register Command) by setting A12 bit to HIGH.
- 5) For two rank modules: for all active current measurements the other rank is in Precharge Power-Down Mode  $I_{DD2P}$
- 6) For details and notes see the relevant INFINEON component data sheet

**Table 27** Definitions for  $I_{DD}$

Parameter	Description
LOW	$V_{IN} \leq V_{IL(ac).MAX}$ , HIGH is defined as $V_{IN} \geq V_{IH(ac).MIN}$
STABLE	inputs are stable at a HIGH or LOW level
FLOATING	inputs are $V_{REF} = V_{DDQ}/2$
SWITCHING	inputs are changing between HIGH and LOW every other clock (once per 2 cycles) for address and control signals, and inputs changing between HIGH and LOW every other data transfer (once per cycle) for DQ signals not including mask or strobes

Electrical Characteristics Currents Specifications and Conditions

Table 28  $I_{DD}$  Specification for HYS[64/72]T[32/64/128]xxxHU-3-A

Product Type	HYS64T32000HU-3-A	HYS64T64000HU-3-A	HYS72T64000HU-3-A	HYS64T128020HU-3-A	HYS72T128020HU-3-A	Unit	Note <sup>1)</sup>
Organization	256MB	512MB	512MB	1GB	1GB		
	1 Rank	1 Rank	1 Rank	2 Ranks	2 Ranks		
	×64	×64	×72	×64	×72		
	-3	-3	-3	-3	-3		
Symbol	Max.	Max.	Max.	Max.	Max.		
$I_{DD0}$	380	600	680	640	720	mA	2)
$I_{DD1}$	440	720	810	760	860	mA	2)
$I_{DD2N}$	200	400	450	800	900	mA	3)
$I_{DD2P}$	20	40	50	80	90	mA	3)
$I_{DD2Q}$	160	320	360	640	720	mA	3)
$I_{DD3N}$	200	400	450	800	900	mA	3)
$I_{DD3P}(MRS = 0)$	80	150	170	300	340	mA	3)
$I_{DD3P}(MRS = 1)$	20	50	50	100	110	mA	3)
$I_{DD4R}$	600	1040	1170	1080	1220	mA	2)
$I_{DD4W}$	680	1120	1260	1160	1310	mA	2)
$I_{DD5B}$	560	1120	1260	1160	1310	mA	2)
$I_{DD5D}$	20	50	50	100	110	mA	3)
$I_{DD6}$	20	40	45	80	90	mA	3)
$I_{DD7}$	960	1240	1400	1280	1440	mA	2)

1) Calculated values from component data. ODT disabled.  $I_{DD1}$ ,  $I_{DD4R}$ , and  $I_{DD7}$ , are defined with the outputs disabled.

2) The other rank is in  $I_{DD2P}$  Precharge Power-Down Standby Current mode

3) Both ranks are in the same  $I_{DD}$  current mode

Electrical Characteristics Currents Specifications and Conditions

Table 29  $I_{DD}$  Specification for HYS[64/72]T[32/64/128]xxxHU-3S-A

Product Type	HYS64T32000HU-3S-A	HYS64T64000HU-3S-A	HYS72T64000HU-3S-A	HYS64T128020HU-3S-A	HYS72T128020HU-3S-A	Unit	Note <sup>1)</sup>
Organization	256MB	512MB	512MB	1GB	1GB		
	1 Rank	1 Rank	1 Rank	2 Ranks	2 Ranks		
	×64	×64	×72	×64	×72		
	-3S	-3S	-3S	-3S	-3S		
Symbol	Max.	Max.	Max.	Max.	Max.		
$I_{DD0}$	360	570	640	610	680	mA	2)
$I_{DD1}$	420	680	770	720	810	mA	2)
$I_{DD2N}$	200	400	450	800	900	mA	3)
$I_{DD2P}$	20	40	50	80	90	mA	3)
$I_{DD2Q}$	160	320	360	640	720	mA	3)
$I_{DD3N}$	200	400	450	800	900	mA	3)
$I_{DD3P(MRS = 0)}$	80	150	170	300	340	mA	3)
$I_{DD3P(MRS = 1)}$	20	50	50	100	110	mA	3)
$I_{DD4R}$	600	1040	1170	1080	1220	mA	2)
$I_{DD4W}$	680	1120	1260	1160	1310	mA	2)
$I_{DD5B}$	560	1120	1260	1160	1310	mA	2)
$I_{DD5D}$	20	50	50	100	110	mA	3)
$I_{DD6}$	20	40	45	80	90	mA	3)
$I_{DD7}$	910	1180	1320	1220	1370	mA	2)

1) Calculated values from component data. ODT disabled.  $I_{DD1}$ ,  $I_{DD4R}$ , and  $I_{DD7}$ , are defined with the outputs disabled.

2) The other rank is in  $I_{DD2P}$  Precharge Power-Down Standby Current mode

3) Both ranks are in the same  $I_{DD}$  current mode



Electrical Characteristics Currents Specifications and Conditions

Table 30  $I_{DD}$  Specification for HYS[64/72]T[32/64/128]xxxHU-3.7-A

Product Type	HYS64T32000HU-3.7-A	HYS64T64000HU-3.7-A	HYS72T64000HU-3.7-A	HYS64T128020HU-3.7-A	HYS72T128020HU-3.7-A	Unit	Note <sup>1)</sup>
Organization	256MB	512MB	512MB	1GB	1GB		
	1 Rank	1 Rank	1 Rank	2 Ranks	2 Ranks		
	×64	×64	×72	×64	×72		
	-3.7	-3.7	-3.7	-3.7	-3.7		
Symbol	Max.	Max.	Max.	Max.	Max.		
$I_{DD0}$	320	520	590	550	620	mA	2)
$I_{DD1}$	360	600	680	630	710	mA	2)
$I_{DD2N}$	160	320	360	640	720	mA	3)
$I_{DD2P}$	20	30	40	60	70	mA	3)
$I_{DD2Q}$	120	240	270	480	540	mA	3)
$I_{DD3N}$	160	320	360	640	720	mA	3)
$I_{DD3P}(MRS = 0)$	60	130	140	260	290	mA	3)
$I_{DD3P}(MRS = 1)$	20	40	50	80	90	mA	3)
$I_{DD4R}$	400	720	810	750	850	mA	2)
$I_{DD4W}$	440	760	860	790	890	mA	2)
$I_{DD5B}$	520	1040	1170	1070	1210	mA	2)
$I_{DD5D}$	20	50	50	100	110	mA	3)
$I_{DD6}$	16	32	36	64	72	mA	3)
$I_{DD7}$	880	1120	1260	1160	1300	mA	2)

1) Calculated values from component data. ODT disabled.  $I_{DD1}$ ,  $I_{DD4R}$ , and  $I_{DD7}$ , are defined with the outputs disabled.

2) The other rank is in  $I_{DD2P}$  Precharge Power-Down Standby Current mode

3) Both ranks are in the same  $I_{DD}$  current mode

Electrical Characteristics Currents Specifications and Conditions

Table 31  $I_{DD}$  Specification for HYS[64/72]T[32/64/128]xxxHU-5-A

Product Type	HYS64T32000HU-5-A	HYS64T64000HU-5-A	HYS72T64000HU-5-A	HYS64T128020HU-5-A	HYS72T128020HU-5-A	Unit	Note <sup>1)</sup>
Organization	256MB	512MB	512MB	1GB	1GB		
	1 Rank	1 Rank	1 Rank	2 Ranks	2 Ranks		
	×64	×64	×72	×64	×72		
	-5	-5	-5	-5	-5		
Symbol	Max.	Max.	Max.	Max.	Max.		
$I_{DD0}$	280	440	500	470	530	mA	2)
$I_{DD1}$	300	480	540	510	580	mA	2)
$I_{DD2N}$	130	260	290	510	580	mA	3)
$I_{DD2P}$	20	30	40	60	70	mA	3)
$I_{DD2Q}$	100	200	230	400	450	mA	3)
$I_{DD3N}$	140	280	320	560	630	mA	3)
$I_{DD3P}(MRS = 0)$	50	100	120	210	230	mA	3)
$I_{DD3P}(MRS = 1)$	20	40	50	80	90	mA	3)
$I_{DD4R}$	340	560	630	590	670	mA	2)
$I_{DD4W}$	360	600	680	630	710	mA	2)
$I_{DD5B}$	480	960	1080	990	1120	mA	2)
$I_{DD5D}$	20	50	50	100	110	mA	3)
$I_{DD6}$	16	32	36	64	72	mA	3)
$I_{DD7}$	840	1040	1170	1070	1210	mA	2)

1) Calculated values from component data. ODT disabled.  $I_{DD1}$ ,  $I_{DD4R}$ , and  $I_{DD7}$ , are defined with the outputs disabled.

2) The other rank is in  $I_{DD2P}$  Precharge Power-Down Standby Current mode

3) Both ranks are in the same  $I_{DD}$  current mode

#### 4.4.1 Currents Test Conditions

For testing the  $I_{DD}$  parameters, the timing parameters as in Table 32 are used.

**Table 32**  $I_{DD}$  Measurement Test Conditions for DDR2-667

Parameter	Symbol	-3	-3S	Unit
		DDR2-667C	DDR2-667D	
CAS Latency	$CL_{(IDD)}$	4	5	$t_{CK}$
Clock Cycle Time	$t_{CK(IDD)}$	3	3.75	ns
Active to Read or Write delay	$t_{RCD(IDD)}$	12	15	ns
Active to Active / Auto-Refresh command period	$t_{RC(IDD)}$	57	60	ns
Active bank A to Active bank B command delay	$\times 8^{(1)}$ $t_{RRD(IDD)}$	7.5	7.5	ns
	$\times 16^{(2)}$ $t_{RRD(IDD)}$	10	10	ns
Active to Precharge Command	$t_{RAS.MIN(IDD)}$	45	45	ns
Active to Precharge Command	$t_{RAS.MAX(IDD)}$	70000	70000	ns
Precharge Command Period	$t_{RP(IDD)}$	12	15	ns
Auto-Refresh to Active / Auto-Refresh command period	$t_{RFC(IDD)}$	105	105	ns
Average periodic Refresh interval	$t_{REFI}$	7.8	7.8	$\mu s$

1)  $\times 4$  &  $\times 8$  (1 kB page size)

2)  $\times 16$  (2 kB page size), not on 256M components

**Table 33**  $I_{DD}$  Measurement Test Conditions for DDR2-400 and DDR2-533

Parameter	Symbol	-3.7	-5	Unit
		DDR2-533C	DDR2-400B	
CAS Latency	$CL_{(IDD)}$	4	3	$t_{CK}$
Clock Cycle Time	$t_{CK(IDD)}$	3.75	5	ns
Active to Read or Write delay	$t_{RCD(IDD)}$	15	15	ns
Active to Active / Auto-Refresh command period	$t_{RC(IDD)}$	60	55	ns
Active bank A to Active bank B command delay	$\times 8^{(1)}$ $t_{RRD(IDD)}$	7.5	7.5	ns
	$\times 16^{(2)}$ $t_{RRD(IDD)}$	10	10	ns
Active to Precharge Command	$t_{RAS.MIN(IDD)}$	45	40	ns
Active to Precharge Command	$t_{RAS.MAX(IDD)}$	70000	70000	ns
Precharge Command Period	$t_{RP(IDD)}$	15	15	ns
Auto-Refresh to Active / Auto-Refresh command period	$t_{RFC(IDD)}$	105	105	ns
Average periodic Refresh interval	$t_{REFI}$	7.8	7.8	$\mu s$

1)  $\times 4$  &  $\times 8$  (1 kB page size)

2)  $\times 16$  (2 kB page size), not on 256M components

#### 4.4.2 On Die Termination (ODT) Current

The ODT function adds additional current consumption to the DDR2 SDRAM when enabled by the EMRS(1). Depending on address bits A[6,2] in the EMRS(1) a “weak” or “strong” termination can be selected. The

current consumption for any terminated input pin, depends on the input pin is in tri-state or driving 0 or 1, as long a ODT is enabled during a given period of time.

**Table 34 ODT current per terminated pin**

Parameter	Symbol	Min.	Typ.	Max.	Unit	EMRS(1) State
<b>Enabled ODT current per DQ</b> ODT is HIGH; Data Bus inputs are FLOATING	$I_{\text{ODTO}}$	5	6	7.5	mA/DQ	A6 = 0, A2 = 1
		2.5	3	3.75	mA/DQ	A6 = 1, A2 = 0
<b>Active ODT current per DQ</b> ODT is HIGH; worst case of Data Bus inputs are STABLE or SWITCHING.	$I_{\text{ODTT}}$	10	12	15	mA/DQ	A6 = 0, A2 = 1
		5	6	7.5	mA/DQ	A6 = 1, A2 = 0

*Note: For power consumption calculations the ODT duty cycle has to be taken into account*

## 5 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 35 “SPD Codes for HYS\[64/72\]T\[32/64/128\]0x0HU-3-A” on Page 45](#)
- [Table 36 “SPD Codes for HYS\[64/72\]T\[32/64/128\]0x0HU-3S-A” on Page 49](#)
- [Table 37 “SPD Codes for HYS\[64/72\]T\[32/64/128\]0x0HU-3.7-A” on Page 53](#)
- [Table 38 “SPD Codes for HYS\[64/72\]T\[32/64/128\]0x0HU-5-A” on Page 57](#)

**Table 35 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3-A**

Product Type		HYS64T32000HU-3-A	HYS64T64000HU-3-A	HYS64T128020HU-3-A	HYS72T64000HU-3-A	HYS72T128020HU-3-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-5300U-444			PC2-5300E-444	
JEDEC SPD Revision		Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2
Byte#	Description	HEX	HEX	HEX	HEX	HEX
0	Programmed SPD Bytes in EEPROM	80	80	80	80	80
1	Total number of Bytes in EEPROM	08	08	08	08	08
2	Memory Type (DDR2)	08	08	08	08	08
3	Number of Row Addresses	0D	0E	0E	0E	0E
4	Number of Column Addresses	0A	0A	0A	0A	0A
5	DIMM Rank and Stacking Information	60	60	61	60	61
6	Data Width	40	40	40	48	48
7	Not used	00	00	00	00	00
8	Interface Voltage Level	05	05	05	05	05
9	$t_{CK} @ CL_{MAX}$ (Byte 18) [ns]	30	30	30	30	30
10	$t_{AC}$ SDRAM @ $CL_{MAX}$ (Byte 18) [ns]	45	45	45	45	45
11	Error Correction Support (non-ECC, ECC)	00	00	00	02	02
12	Refresh Rate and Type	82	82	82	82	82
13	Primary SDRAM Width	10	08	08	08	08
14	Error Checking SDRAM Width	00	00	00	08	08
15	Not used	00	00	00	00	00
16	Burst Length Supported	0C	0C	0C	0C	0C

Table 35 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3-A (cont'd)

Product Type		HYS64T32000HU-3-A	HYS64T64000HU-3-A	HYS64T128020HU-3-A	HYS72T64000HU-3-A	HYS72T128020HU-3-A
Organization		256MB ×64 1 Rank (×16)	512MB ×64 1 Rank (×8)	1GB ×64 2 Ranks (×8)	512MB ×72 1 Rank (×8)	1GB ×72 2 Ranks (×8)
Label Code		PC2-5300U-444			PC2-5300E-444	
JEDEC SPD Revision		Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2
Byte#	Description	HEX	HEX	HEX	HEX	HEX
17	Number of Banks on SDRAM Device	04	04	04	04	04
18	Supported CAS Latencies	38	38	38	38	38
19	DIMM Mechanical Characteristics	01	01	01	01	01
20	DIMM Type Information	02	02	02	02	02
21	DIMM Attributes	00	00	00	00	00
22	Component Attributes	03	03	03	03	03
23	$t_{CK} @ CL_{MAX} -1$ (Byte 18) [ns]	30	30	30	30	30
24	$t_{AC}$ SDRAM @ $CL_{MAX} -1$ [ns]	45	45	45	45	45
25	$t_{CK} @ CL_{MAX} -2$ (Byte 18) [ns]	50	50	50	50	50
26	$t_{AC}$ SDRAM @ $CL_{MAX} -2$ [ns]	60	60	60	60	60
27	$t_{RP.MIN}$ [ns]	30	30	30	30	30
28	$t_{RRD.MIN}$ [ns]	28	1E	1E	1E	1E
29	$t_{RCD.MIN}$ [ns]	30	30	30	30	30
30	$t_{RAS.MIN}$ [ns]	2D	2D	2D	2D	2D
31	Module Density per Rank	40	80	80	80	80
32	$t_{AS.MIN}$ and $t_{CS.MIN}$ [ns]	20	20	20	20	20
33	$t_{AH.MIN}$ and $t_{CH.MIN}$ [ns]	27	27	27	27	27
34	$t_{DS.MIN}$ [ns]	10	10	10	10	10
35	$t_{DH.MIN}$ [ns]	17	17	17	17	17
36	$t_{WR.MIN}$ [ns]	3C	3C	3C	3C	3C
37	$t_{WTR.MIN}$ [ns]	1E	1E	1E	1E	1E
38	$t_{RTP.MIN}$ [ns]	1E	1E	1E	1E	1E
39	Analysis Characteristics	00	00	00	00	00
40	$t_{RC}$ and $t_{RFC}$ Extension	00	00	00	00	00
41	$t_{RC.MIN}$ [ns]	39	39	39	39	39
42	$t_{RFC.MIN}$ [ns]	69	69	69	69	69
43	$t_{CK.MAX}$ [ns]	80	80	80	80	80
44	$t_{DQSQ.MAX}$ [ns]	18	18	18	18	18

Table 35 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3-A (cont'd)

Product Type		HYS64T32000HU-3-A	HYS64T64000HU-3-A	HYS64T128020HU-3-A	HYS72T64000HU-3-A	HYS72T128020HU-3-A
Organization		256MB ×64 1 Rank (×16)	512MB ×64 1 Rank (×8)	1GB ×64 2 Ranks (×8)	512MB ×72 1 Rank (×8)	1GB ×72 2 Ranks (×8)
Label Code		PC2-5300U-444			PC2-5300E-444	
JEDEC SPD Revision		Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2
Byte#	Description	HEX	HEX	HEX	HEX	HEX
45	$t_{QHS.MAX}$ [ns]	22	22	22	22	22
46	PLL Relock Time	00	00	00	00	00
47	$T_{CASE.MAX}$ Delta / $\Delta T_{4R4W}$ Delta	55	53	53	53	53
48	Psi(T-A) DRAM	72	78	78	78	78
49	$\Delta T_0$ (DT0)	67	4F	4F	4F	4F
50	$\Delta T_{2N}$ (DT2N, UDIMM) or $\Delta T_{2Q}$ (DT2Q, RDIMM)	36	39	39	39	39
51	$\Delta T_{2P}$ (DT2P)	24	26	26	26	26
52	$\Delta T_{3N}$ (DT3N)	24	26	26	26	26
53	$\Delta T_{3P.fast}$ (DT3P fast)	29	2B	2B	2B	2B
54	$\Delta T_{3P.slow}$ (DT3P slow)	1A	1B	1B	1B	1B
55	$\Delta T_{4R}$ (DT4R) / $\Delta T_{4R4W}$ Sign (DT4R4W)	52	4A	4A	4A	4A
56	$\Delta T_{5B}$ (DT5B)	1E	20	20	20	20
57	$\Delta T_7$ (DT7)	34	23	23	23	23
58	Psi(ca) PLL	00	00	00	00	00
59	Psi(ca) REG	00	00	00	00	00
60	$\Delta T_{PLL}$ (DTPLL)	00	00	00	00	00
61	$\Delta T_{REG}$ (DTREG) / Toggle Rate	00	00	00	00	00
62	SPD Revision	12	12	12	12	12
63	Checksum of Bytes 0-62	A2	B0	B1	C2	C3
64	JEDEC ID Code of Infineon (1)	C1	C1	C1	C1	C1
65	JEDEC ID Code of Infineon (2)	00	00	00	00	00
66	JEDEC ID Code of Infineon (3)	00	00	00	00	00
67	JEDEC ID Code of Infineon (4)	00	00	00	00	00
68	JEDEC ID Code of Infineon (5)	00	00	00	00	00
69	JEDEC ID Code of Infineon (6)	00	00	00	00	00
70	JEDEC ID Code of Infineon (7)	00	00	00	00	00
71	JEDEC ID Code of Infineon (8)	00	00	00	00	00
72	Module Manufacturer Location	xx	xx	xx	xx	xx

Table 35 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3-A (cont'd)

Product Type		HYS64T32000HU-3-A	HYS64T64000HU-3-A	HYS64T128020HU-3-A	HYS72T64000HU-3-A	HYS72T128020HU-3-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-5300U-444			PC2-5300E-444	
JEDEC SPD Revision		Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2
Byte#	Description	HEX	HEX	HEX	HEX	HEX
73	Product Type, Char 1	36	36	36	37	37
74	Product Type, Char 2	34	34	34	32	32
75	Product Type, Char 3	54	54	54	54	54
76	Product Type, Char 4	33	36	31	36	31
77	Product Type, Char 5	32	34	32	34	32
78	Product Type, Char 6	30	30	38	30	38
79	Product Type, Char 7	30	30	30	30	30
80	Product Type, Char 8	30	30	32	30	32
81	Product Type, Char 9	48	48	30	48	30
82	Product Type, Char 10	55	55	48	55	48
83	Product Type, Char 11	33	33	55	33	55
84	Product Type, Char 12	41	41	33	41	33
85	Product Type, Char 13	20	20	41	20	41
86	Product Type, Char 14	20	20	20	20	20
87	Product Type, Char 15	20	20	20	20	20
88	Product Type, Char 16	20	20	20	20	20
89	Product Type, Char 17	20	20	20	20	20
90	Product Type, Char 18	20	20	20	20	20
91	Module Revision Code	5x	7x	7x	7x	7x
92	Test Program Revision Code	xx	xx	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx	xx	xx
99 - 127	Not used	00	00	00	00	00



Table 36 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3S-A

Product Type		HYS64T32000HU-3S-A	HYS64T64000HU-3S-A	HYS64T128020HU-3S-A	HYS72T64000HU-3S-A	HYS72T128020HU-3S-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-5300U-555			PC2-5300E-555	
JEDEC SPD Revision		Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2
Byte#	Description	HEX	HEX	HEX	HEX	HEX
0	Programmed SPD Bytes in EEPROM	80	80	80	80	80
1	Total number of Bytes in EEPROM	08	08	08	08	08
2	Memory Type (DDR2)	08	08	08	08	08
3	Number of Row Addresses	0D	0E	0E	0E	0E
4	Number of Column Addresses	0A	0A	0A	0A	0A
5	DIMM Rank and Stacking Information	60	60	61	60	61
6	Data Width	40	40	40	48	48
7	Not used	00	00	00	00	00
8	Interface Voltage Level	05	05	05	05	05
9	$t_{CK} @ CL_{MAX}$ (Byte 18) [ns]	30	30	30	30	30
10	$t_{AC}$ SDRAM @ $CL_{MAX}$ (Byte 18) [ns]	45	45	45	45	45
11	Error Correction Support (non-ECC, ECC)	00	00	00	02	02
12	Refresh Rate and Type	82	82	82	82	82
13	Primary SDRAM Width	10	08	08	08	08
14	Error Checking SDRAM Width	00	00	00	08	08
15	Not used	00	00	00	00	00
16	Burst Length Supported	0C	0C	0C	0C	0C
17	Number of Banks on SDRAM Device	04	04	04	04	04
18	Supported CAS Latencies	38	38	38	38	38
19	DIMM Mechanical Characteristics	01	01	01	01	01
20	DIMM Type Information	02	02	02	02	02
21	DIMM Attributes	00	00	00	00	00
22	Component Attributes	03	03	03	03	03
23	$t_{CK} @ CL_{MAX} -1$ (Byte 18) [ns]	3D	3D	3D	3D	3D
24	$t_{AC}$ SDRAM @ $CL_{MAX} -1$ [ns]	50	50	50	50	50
25	$t_{CK} @ CL_{MAX} -2$ (Byte 18) [ns]	50	50	50	50	50
26	$t_{AC}$ SDRAM @ $CL_{MAX} -2$ [ns]	60	60	60	60	60

Table 36 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3S-A (cont'd)

Product Type		HYS64T32000HU-3S-A	HYS64T64000HU-3S-A	HYS64T128020HU-3S-A	HYS72T64000HU-3S-A	HYS72T128020HU-3S-A
Organization		256MB ×64 1 Rank (×16)	512MB ×64 1 Rank (×8)	1GB ×64 2 Ranks (×8)	512MB ×72 1 Rank (×8)	1GB ×72 2 Ranks (×8)
Label Code		PC2-5300U-555			PC2-5300E-555	
JEDEC SPD Revision		Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2
Byte#	Description	HEX	HEX	HEX	HEX	HEX
27	$t_{RP.MIN}$ [ns]	3C	3C	3C	3C	3C
28	$t_{RRD.MIN}$ [ns]	28	1E	1E	1E	1E
29	$t_{RCD.MIN}$ [ns]	3C	3C	3C	3C	3C
30	$t_{RAS.MIN}$ [ns]	2D	2D	2D	2D	2D
31	Module Density per Rank	40	80	80	80	80
32	$t_{AS.MIN}$ and $t_{CS.MIN}$ [ns]	20	20	20	20	20
33	$t_{AH.MIN}$ and $t_{CH.MIN}$ [ns]	27	27	27	27	27
34	$t_{DS.MIN}$ [ns]	10	10	10	10	10
35	$t_{DH.MIN}$ [ns]	17	17	17	17	17
36	$t_{WR.MIN}$ [ns]	3C	3C	3C	3C	3C
37	$t_{WTR.MIN}$ [ns]	1E	1E	1E	1E	1E
38	$t_{RTP.MIN}$ [ns]	1E	1E	1E	1E	1E
39	Analysis Characteristics	00	00	00	00	00
40	$t_{RC}$ and $t_{RFC}$ Extension	00	00	00	00	00
41	$t_{RC.MIN}$ [ns]	3C	3C	3C	3C	3C
42	$t_{RFC.MIN}$ [ns]	69	69	69	69	69
43	$t_{CK.MAX}$ [ns]	80	80	80	80	80
44	$t_{DQSQ.MAX}$ [ns]	18	18	18	18	18
45	$t_{QHS.MAX}$ [ns]	22	22	22	22	22
46	PLL Relock Time	00	00	00	00	00
47	$T_{CASE.MAX}$ Delta / $\Delta T_{4R4W}$ Delta	55	53	53	53	53
48	Psi(T-A) DRAM	72	78	78	78	78
49	$\Delta T_0$ (DT0)	5F	4B	4B	4B	4B
50	$\Delta T_{2N}$ (DT2N, UDIMM) or $\Delta T_{2Q}$ (DT2Q, RDIMM)	36	39	39	39	39
51	$\Delta T_{2P}$ (DT2P)	24	26	26	26	26
52	$\Delta T_{3N}$ (DT3N)	24	26	26	26	26

Table 36 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3S-A (cont'd)

Product Type		HYS64T32000HU-3S-A	HYS64T64000HU-3S-A	HYS64T128020HU-3S-A	HYS72T64000HU-3S-A	HYS72T128020HU-3S-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-5300U-555			PC2-5300E-555	
JEDEC SPD Revision		Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2
Byte#	Description	HEX	HEX	HEX	HEX	HEX
53	$\Delta T_{3P.fast}$ (DT3P fast)	29	2B	2B	2B	2B
54	$\Delta T_{3P.slow}$ (DT3P slow)	1A	1B	1B	1B	1B
55	$\Delta T_{4R}$ (DT4R) / $\Delta T_{4R4W}$ Sign (DT4R4W)	52	4A	4A	4A	4A
56	$\Delta T_{5B}$ (DT5B)	1E	20	20	20	20
57	$\Delta T_7$ (DT7)	31	22	22	22	22
58	Psi(ca) PLL	00	00	00	00	00
59	Psi(ca) REG	00	00	00	00	00
60	$\Delta T_{PLL}$ (DTPLL)	00	00	00	00	00
61	$\Delta T_{REG}$ (DTREG) / Toggle Rate	00	00	00	00	00
62	SPD Revision	12	12	12	12	12
63	Checksum of Bytes 0-62	CA	DE	DF	F0	F1
64	JEDEC ID Code of Infineon (1)	C1	C1	C1	C1	C1
65	JEDEC ID Code of Infineon (2)	00	00	00	00	00
66	JEDEC ID Code of Infineon (3)	00	00	00	00	00
67	JEDEC ID Code of Infineon (4)	00	00	00	00	00
68	JEDEC ID Code of Infineon (5)	00	00	00	00	00
69	JEDEC ID Code of Infineon (6)	00	00	00	00	00
70	JEDEC ID Code of Infineon (7)	00	00	00	00	00
71	JEDEC ID Code of Infineon (8)	00	00	00	00	00
72	Module Manufacturer Location	xx	xx	xx	xx	xx
73	Product Type, Char 1	36	36	36	37	37
74	Product Type, Char 2	34	34	34	32	32
75	Product Type, Char 3	54	54	54	54	54
76	Product Type, Char 4	33	36	31	36	31
77	Product Type, Char 5	32	34	32	34	32
78	Product Type, Char 6	30	30	38	30	38
79	Product Type, Char 7	30	30	30	30	30

Table 36 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3S-A (cont'd)

Product Type		HYS64T32000HU-3S-A	HYS64T64000HU-3S-A	HYS64T128020HU-3S-A	HYS72T64000HU-3S-A	HYS72T128020HU-3S-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-5300U-555			PC2-5300E-555	
JEDEC SPD Revision		Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2	Rev. 1.2
Byte#	Description	HEX	HEX	HEX	HEX	HEX
80	Product Type, Char 8	30	30	32	30	32
81	Product Type, Char 9	48	48	30	48	30
82	Product Type, Char 10	55	55	48	55	48
83	Product Type, Char 11	33	33	55	33	55
84	Product Type, Char 12	53	53	33	53	33
85	Product Type, Char 13	41	41	53	41	53
86	Product Type, Char 14	20	20	41	20	41
87	Product Type, Char 15	20	20	20	20	20
88	Product Type, Char 16	20	20	20	20	20
89	Product Type, Char 17	20	20	20	20	20
90	Product Type, Char 18	20	20	20	20	20
91	Module Revision Code	2x	2x	2x	2x	2x
92	Test Program Revision Code	xx	xx	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx	xx	xx
99 - 127	Not used	00	00	00	00	00

Table 37 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3.7-A

Product Type		HYS64T32000HU-3.7-A	HYS64T64000HU-3.7-A	HYS64T128020HU-3.7-A	HYS72T64000HU-3.7-A	HYS72T128020HU-3.7-A
Organization		256MB ×64 1 Rank (×16)	512MB ×64 1 Rank (×8)	1GB ×64 2 Ranks (×8)	512MB ×72 1 Rank (×8)	1GB ×72 2 Ranks (×8)
Label Code		PC2-4200U-444			PC2-4200E-444	
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX	HEX	HEX
0	Programmed SPD Bytes in EEPROM	80	80	80	80	80
1	Total number of Bytes in EEPROM	08	08	08	08	08
2	Memory Type (DDR2)	08	08	08	08	08
3	Number of Row Addresses	0D	0E	0E	0E	0E
4	Number of Column Addresses	0A	0A	0A	0A	0A
5	DIMM Rank and Stacking Information	60	60	61	60	61
6	Data Width	40	40	40	48	48
7	Not used	00	00	00	00	00
8	Interface Voltage Level	05	05	05	05	05
9	$t_{CK} @ CL_{MAX}$ (Byte 18) [ns]	3D	3D	3D	3D	3D
10	$t_{AC}$ SDRAM @ $CL_{MAX}$ (Byte 18) [ns]	50	50	50	50	50
11	Error Correction Support (non-ECC, ECC)	00	00	00	02	02
12	Refresh Rate and Type	82	82	82	82	82
13	Primary SDRAM Width	10	08	08	08	08
14	Error Checking SDRAM Width	00	00	00	08	08
15	Not used	00	00	00	00	00
16	Burst Length Supported	0C	0C	0C	0C	0C
17	Number of Banks on SDRAM Device	04	04	04	04	04
18	Supported CAS Latencies	38	38	38	38	38
19	DIMM Mechanical Characteristics	00	00	00	00	00
20	DIMM Type Information	02	02	02	02	02
21	DIMM Attributes	00	00	00	00	00
22	Component Attributes	01	01	01	01	01
23	$t_{CK} @ CL_{MAX} -1$ (Byte 18) [ns]	3D	3D	3D	3D	3D
24	$t_{AC}$ SDRAM @ $CL_{MAX} -1$ [ns]	50	50	50	50	50
25	$t_{CK} @ CL_{MAX} -2$ (Byte 18) [ns]	50	50	50	50	50

Table 37 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3.7-A (cont'd)

Product Type		HYS64T32000HU-3.7-A	HYS64T64000HU-3.7-A	HYS64T128020HU-3.7-A	HYS72T64000HU-3.7-A	HYS72T128020HU-3.7-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-4200U-444			PC2-4200E-444	
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX	HEX	HEX
26	$t_{AC}$ SDRAM @ $CL_{MAX} - 2$ [ns]	60	60	60	60	60
27	$t_{RP.MIN}$ [ns]	3C	3C	3C	3C	3C
28	$t_{RRD.MIN}$ [ns]	28	1E	1E	1E	1E
29	$t_{RCD.MIN}$ [ns]	3C	3C	3C	3C	3C
30	$t_{RAS.MIN}$ [ns]	2D	2D	2D	2D	2D
31	Module Density per Rank	40	80	80	80	80
32	$t_{AS.MIN}$ and $t_{CS.MIN}$ [ns]	25	25	25	25	25
33	$t_{AH.MIN}$ and $t_{CH.MIN}$ [ns]	37	37	37	37	37
34	$t_{DS.MIN}$ [ns]	10	10	10	10	10
35	$t_{DH.MIN}$ [ns]	22	22	22	22	22
36	$t_{WR.MIN}$ [ns]	3C	3C	3C	3C	3C
37	$t_{WTR.MIN}$ [ns]	1E	1E	1E	1E	1E
38	$t_{RTP.MIN}$ [ns]	1E	1E	1E	1E	1E
39	Analysis Characteristics	00	00	00	00	00
40	$t_{RC}$ and $t_{RFC}$ Extension	00	00	00	00	00
41	$t_{RC.MIN}$ [ns]	3C	3C	3C	3C	3C
42	$t_{RFC.MIN}$ [ns]	69	69	69	69	69
43	$t_{CK.MAX}$ [ns]	80	80	80	80	80
44	$t_{DQSQ.MAX}$ [ns]	1E	1E	1E	1E	1E
45	$t_{QHS.MAX}$ [ns]	28	28	28	28	28
46	PLL Relock Time	00	00	00	00	00
47	$T_{CASE.MAX}$ Delta / $\Delta T_{4R4W}$ Delta	53	51	51	51	51
48	Psi(T-A) DRAM	72	78	78	78	78
49	$\Delta T_0$ (DT0)	53	3F	3F	3F	3F
50	$\Delta T_{2N}$ (DT2N, UDIMM) or $\Delta T_{2Q}$ (DT2Q, RDIMM)	2B	2E	2E	2E	2E
51	$\Delta T_{2P}$ (DT2P)	1D	1E	1E	1E	1E
52	$\Delta T_{3N}$ (DT3N)	1D	1E	1E	1E	1E

Table 37 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3.7-A (cont'd)

Product Type		HYS64T32000HU-3.7-A	HYS64T64000HU-3.7-A	HYS64T128020HU-3.7-A	HYS72T64000HU-3.7-A	HYS72T128020HU-3.7-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-4200U-444			PC2-4200E-444	
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX	HEX	HEX
53	$\Delta T_{3P.fast}$ (DT3P fast)	23	24	24	24	24
54	$\Delta T_{3P.slow}$ (DT3P slow)	16	17	17	17	17
55	$\Delta T_{4R}$ (DT4R) / $\Delta T_{4R4W}$ Sign (DT4R4W)	36	34	34	34	34
56	$\Delta T_{5B}$ (DT5B)	1C	1E	1E	1E	1E
57	$\Delta T_7$ (DT7)	30	20	20	20	20
58	Psi(ca) PLL	00	00	00	00	00
59	Psi(ca) REG	00	00	00	00	00
60	$\Delta T_{PLL}$ (DTPLL)	00	00	00	00	00
61	$\Delta T_{REG}$ (DTREG) / Toggle Rate	00	00	00	00	00
62	SPD Revision	11	11	11	11	11
63	Checksum of Bytes 0-62	BA	D0	D1	E2	E3
64	JEDEC ID Code of Infineon (1)	C1	C1	C1	C1	C1
65	JEDEC ID Code of Infineon (2)	00	00	00	00	00
66	JEDEC ID Code of Infineon (3)	00	00	00	00	00
67	JEDEC ID Code of Infineon (4)	00	00	00	00	00
68	JEDEC ID Code of Infineon (5)	00	00	00	00	00
69	JEDEC ID Code of Infineon (6)	00	00	00	00	00
70	JEDEC ID Code of Infineon (7)	00	00	00	00	00
71	JEDEC ID Code of Infineon (8)	00	00	00	00	00
72	Module Manufacturer Location	xx	xx	xx	xx	xx
73	Product Type, Char 1	36	36	36	37	37
74	Product Type, Char 2	34	34	34	32	32
75	Product Type, Char 3	54	54	54	54	54
76	Product Type, Char 4	33	36	31	36	31
77	Product Type, Char 5	32	34	32	34	32
78	Product Type, Char 6	30	30	38	30	38
79	Product Type, Char 7	30	30	30	30	30

Table 37 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-3.7-A (cont'd)

Product Type		HYS64T32000HU-3.7-A	HYS64T64000HU-3.7-A	HYS64T128020HU-3.7-A	HYS72T64000HU-3.7-A	HYS72T128020HU-3.7-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-4200U-444			PC2-4200E-444	
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX	HEX	HEX
80	Product Type, Char 8	30	30	32	30	32
81	Product Type, Char 9	48	48	30	48	30
82	Product Type, Char 10	55	55	48	55	48
83	Product Type, Char 11	33	33	55	33	55
84	Product Type, Char 12	2E	2E	33	2E	33
85	Product Type, Char 13	37	37	2E	37	2E
86	Product Type, Char 14	41	41	37	41	37
87	Product Type, Char 15	20	20	41	20	41
88	Product Type, Char 16	20	20	20	20	20
89	Product Type, Char 17	20	20	20	20	20
90	Product Type, Char 18	20	20	20	20	20
91	Module Revision Code	3x	3x	3x	3x	3x
92	Test Program Revision Code	xx	xx	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx	xx	xx
99 - 127	Not used	00	00	00	00	00



Table 38 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-5-A

Product Type		HYS64T32000HU-5-A	HYS64T64000HU-5-A	HYS64T128020HU-5-A	HYS72T64000HU-5-A	HYS72T128020HU-5-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-3200U-333			PC2-3200E-333	
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX	HEX	HEX
0	Programmed SPD Bytes in EEPROM	80	80	80	80	80
1	Total number of Bytes in EEPROM	08	08	08	08	08
2	Memory Type (DDR2)	08	08	08	08	08
3	Number of Row Addresses	0D	0E	0E	0E	0E
4	Number of Column Addresses	0A	0A	0A	0A	0A
5	DIMM Rank and Stacking Information	60	60	61	60	61
6	Data Width	40	40	40	48	48
7	Not used	00	00	00	00	00
8	Interface Voltage Level	05	05	05	05	05
9	$t_{CK}$ @ $CL_{MAX}$ (Byte 18) [ns]	50	50	50	50	50
10	$t_{AC}$ SDRAM @ $CL_{MAX}$ (Byte 18) [ns]	60	60	60	60	60
11	Error Correction Support (non-ECC, ECC)	00	00	00	02	02
12	Refresh Rate and Type	82	82	82	82	82
13	Primary SDRAM Width	10	08	08	08	08
14	Error Checking SDRAM Width	00	00	00	08	08
15	Not used	00	00	00	00	00
16	Burst Length Supported	0C	0C	0C	0C	0C
17	Number of Banks on SDRAM Device	04	04	04	04	04
18	Supported CAS Latencies	38	38	38	38	38
19	DIMM Mechanical Characteristics	00	00	00	00	00
20	DIMM Type Information	02	02	02	02	02
21	DIMM Attributes	00	00	00	00	00
22	Component Attributes	01	01	01	01	01
23	$t_{CK}$ @ $CL_{MAX}$ -1 (Byte 18) [ns]	50	50	50	50	50
24	$t_{AC}$ SDRAM @ $CL_{MAX}$ -1 [ns]	60	60	60	60	60
25	$t_{CK}$ @ $CL_{MAX}$ -2 (Byte 18) [ns]	50	50	50	50	50
26	$t_{AC}$ SDRAM @ $CL_{MAX}$ -2 [ns]	60	60	60	60	60

Table 38 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-5-A (cont'd)

Product Type		HYS64T32000HU-5-A	HYS64T64000HU-5-A	HYS64T128020HU-5-A	HYS72T64000HU-5-A	HYS72T128020HU-5-A
Organization		256MB ×64 1 Rank (×16)	512MB ×64 1 Rank (×8)	1GB ×64 2 Ranks (×8)	512MB ×72 1 Rank (×8)	1GB ×72 2 Ranks (×8)
Label Code		PC2-3200U-333			PC2-3200E-333	
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX	HEX	HEX
27	$t_{RP.MIN}$ [ns]	3C	3C	3C	3C	3C
28	$t_{RRD.MIN}$ [ns]	28	1E	1E	1E	1E
29	$t_{RCD.MIN}$ [ns]	3C	3C	3C	3C	3C
30	$t_{RAS.MIN}$ [ns]	28	28	28	28	28
31	Module Density per Rank	40	80	80	80	80
32	$t_{AS.MIN}$ and $t_{CS.MIN}$ [ns]	35	35	35	35	35
33	$t_{AH.MIN}$ and $t_{CH.MIN}$ [ns]	47	47	47	47	47
34	$t_{DS.MIN}$ [ns]	15	15	15	15	15
35	$t_{DH.MIN}$ [ns]	27	27	27	27	27
36	$t_{WR.MIN}$ [ns]	3C	3C	3C	3C	3C
37	$t_{WTR.MIN}$ [ns]	28	28	28	28	28
38	$t_{RTP.MIN}$ [ns]	1E	1E	1E	1E	1E
39	Analysis Characteristics	00	00	00	00	00
40	$t_{RC}$ and $t_{RFC}$ Extension	00	00	00	00	00
41	$t_{RC.MIN}$ [ns]	37	37	37	37	37
42	$t_{RFC.MIN}$ [ns]	69	69	69	69	69
43	$t_{CK.MAX}$ [ns]	80	80	80	80	80
44	$t_{DQSQ.MAX}$ [ns]	23	23	23	23	23
45	$t_{QHS.MAX}$ [ns]	2D	2D	2D	2D	2D
46	PLL Relock Time	00	00	00	00	00
47	$T_{CASE.MAX}$ Delta / $\Delta T_{4R4W}$ Delta	51	51	51	51	51
48	Psi(T-A) DRAM	72	78	78	78	78
49	$\Delta T_0$ (DT0)	43	33	33	33	33
50	$\Delta T_{2N}$ (DT2N, UDIMM) or $\Delta T_{2Q}$ (DT2Q, RDIMM)	23	24	24	24	24
51	$\Delta T_{2P}$ (DT2P)	1D	1E	1E	1E	1E
52	$\Delta T_{3N}$ (DT3N)	19	1B	1B	1B	1B
53	$\Delta T_{3P.fast}$ (DT3P fast)	1C	1E	1E	1E	1E
54	$\Delta T_{3P.slow}$ (DT3P slow)	16	17	17	17	17

Table 38 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-5-A (cont'd)

Product Type		HYS64T32000HU-5-A	HYS64T64000HU-5-A	HYS64T128020HU-5-A	HYS72T64000HU-5-A	HYS72T128020HU-5-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-3200U-333			PC2-3200E-333	
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX	HEX	HEX
55	$\Delta T_{4R}$ (DT4R) / $\Delta T_{4R4W}$ Sign (DT4R4W)	2E	28	28	28	28
56	$\Delta T_{5B}$ (DT5B)	1A	1B	1B	1B	1B
57	$\Delta T_7$ (DT7)	2D	1E	1E	1E	1E
58	Psi(ca) PLL	00	00	00	00	00
59	Psi(ca) REG	00	00	00	00	00
60	$\Delta T_{PLL}$ (DTPLL)	00	00	00	00	00
61	$\Delta T_{REG}$ (DTREG) / Toggle Rate	00	00	00	00	00
62	SPD Revision	11	11	11	11	11
63	Checksum of Bytes 0-62	02	1A	1B	2C	2D
64	JEDEC ID Code of Infineon (1)	C1	C1	C1	C1	C1
65	JEDEC ID Code of Infineon (2)	00	00	00	00	00
66	JEDEC ID Code of Infineon (3)	00	00	00	00	00
67	JEDEC ID Code of Infineon (4)	00	00	00	00	00
68	JEDEC ID Code of Infineon (5)	00	00	00	00	00
69	JEDEC ID Code of Infineon (6)	00	00	00	00	00
70	JEDEC ID Code of Infineon (7)	00	00	00	00	00
71	JEDEC ID Code of Infineon (8)	00	00	00	00	00
72	Module Manufacturer Location	xx	xx	xx	xx	xx
73	Product Type, Char 1	36	36	36	37	37
74	Product Type, Char 2	34	34	34	32	32
75	Product Type, Char 3	54	54	54	54	54
76	Product Type, Char 4	33	36	31	36	31
77	Product Type, Char 5	32	34	32	34	32
78	Product Type, Char 6	30	30	38	30	38
79	Product Type, Char 7	30	30	30	30	30
80	Product Type, Char 8	30	30	32	30	32
81	Product Type, Char 9	48	48	30	48	30
82	Product Type, Char 10	55	55	48	55	48

Table 38 SPD Codes for HYS[64/72]T[32/64/128]0x0HU-5-A (cont'd)

Product Type		HYS64T32000HU-5-A	HYS64T64000HU-5-A	HYS64T128020HU-5-A	HYS72T64000HU-5-A	HYS72T128020HU-5-A
Organization		256MB	512MB	1GB	512MB	1GB
		×64	×64	×64	×72	×72
		1 Rank (×16)	1 Rank (×8)	2 Ranks (×8)	1 Rank (×8)	2 Ranks (×8)
Label Code		PC2-3200U-333			PC2-3200E-333	
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX	HEX	HEX
83	Product Type, Char 11	35	35	55	35	55
84	Product Type, Char 12	41	41	35	41	35
85	Product Type, Char 13	20	20	41	20	41
86	Product Type, Char 14	20	20	20	20	20
87	Product Type, Char 15	20	20	20	20	20
88	Product Type, Char 16	20	20	20	20	20
89	Product Type, Char 17	20	20	20	20	20
90	Product Type, Char 18	20	20	20	20	20
91	Module Revision Code	3x	3x	3x	3x	3x
92	Test Program Revision Code	xx	xx	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx	xx	xx
95 - 98	Module Serial Number	xx	xx	xx	xx	xx
99 - 127	Not used	00	00	00	00	00

## 6 Package Outlines

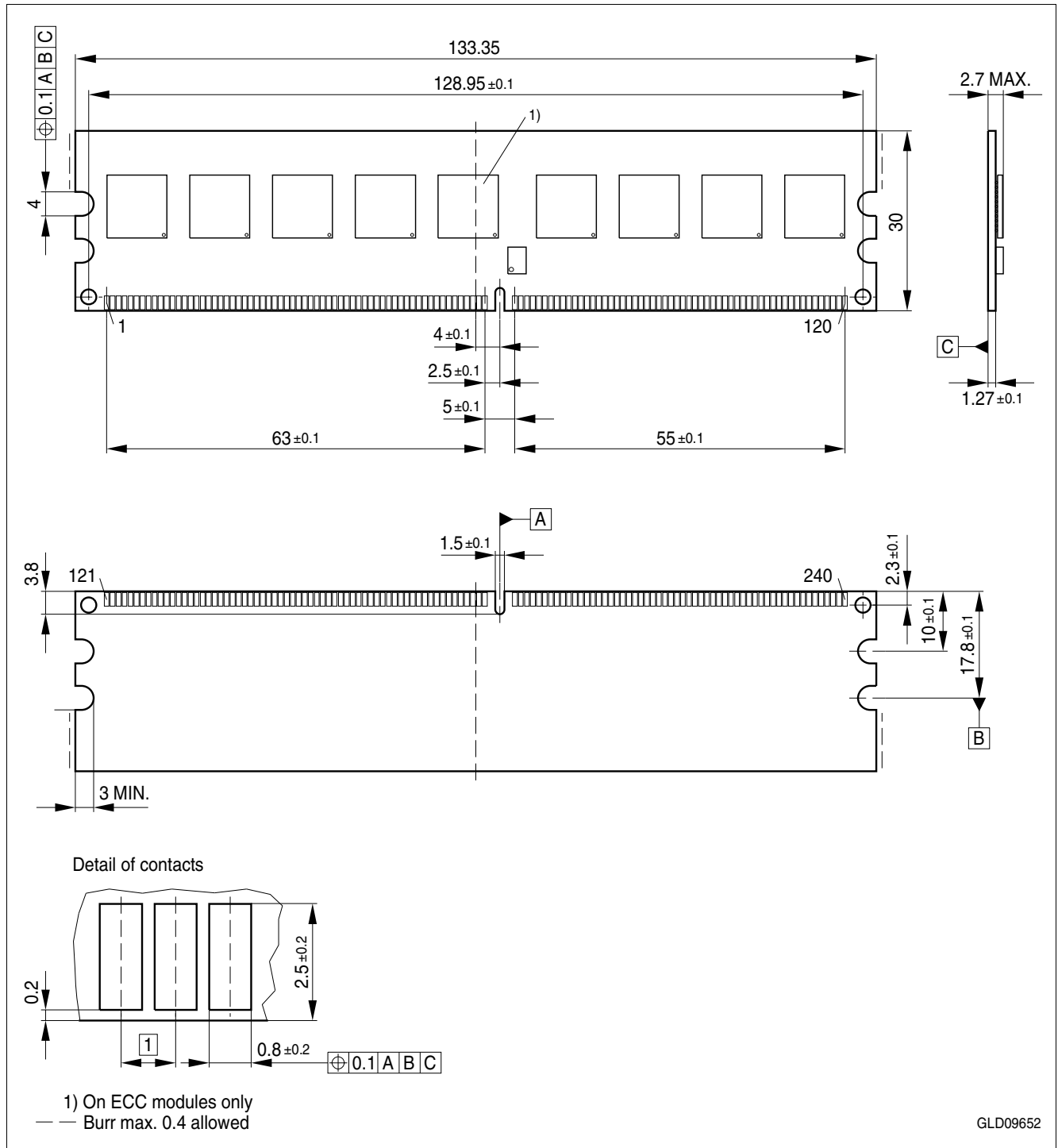


Figure 12 Package Outline Raw Card A L-DIM-240-1

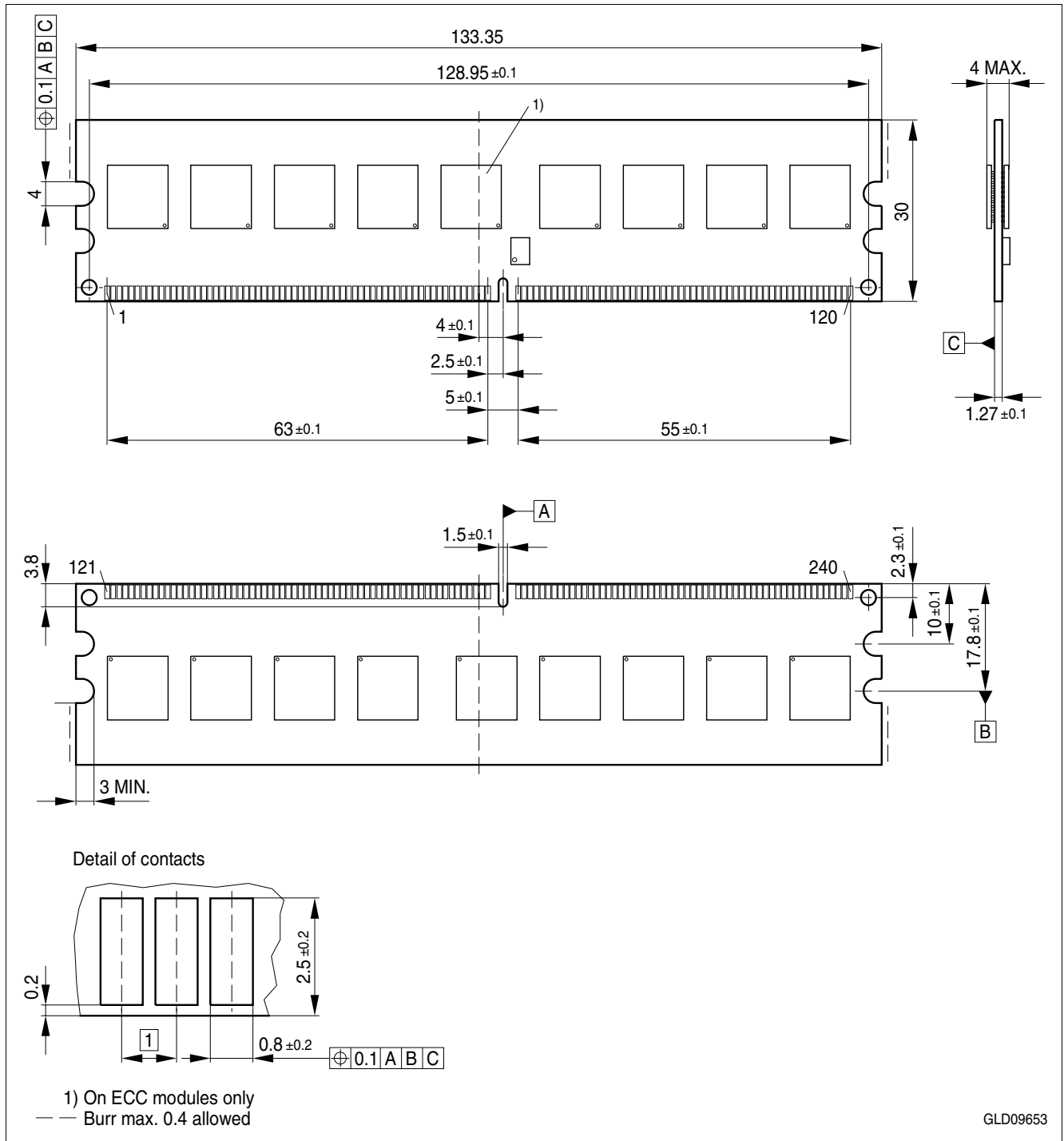


Figure 13 Package Outline Raw Card B L-DIM-240-2

#### Notes

1. The chip is only found on ECC modules.

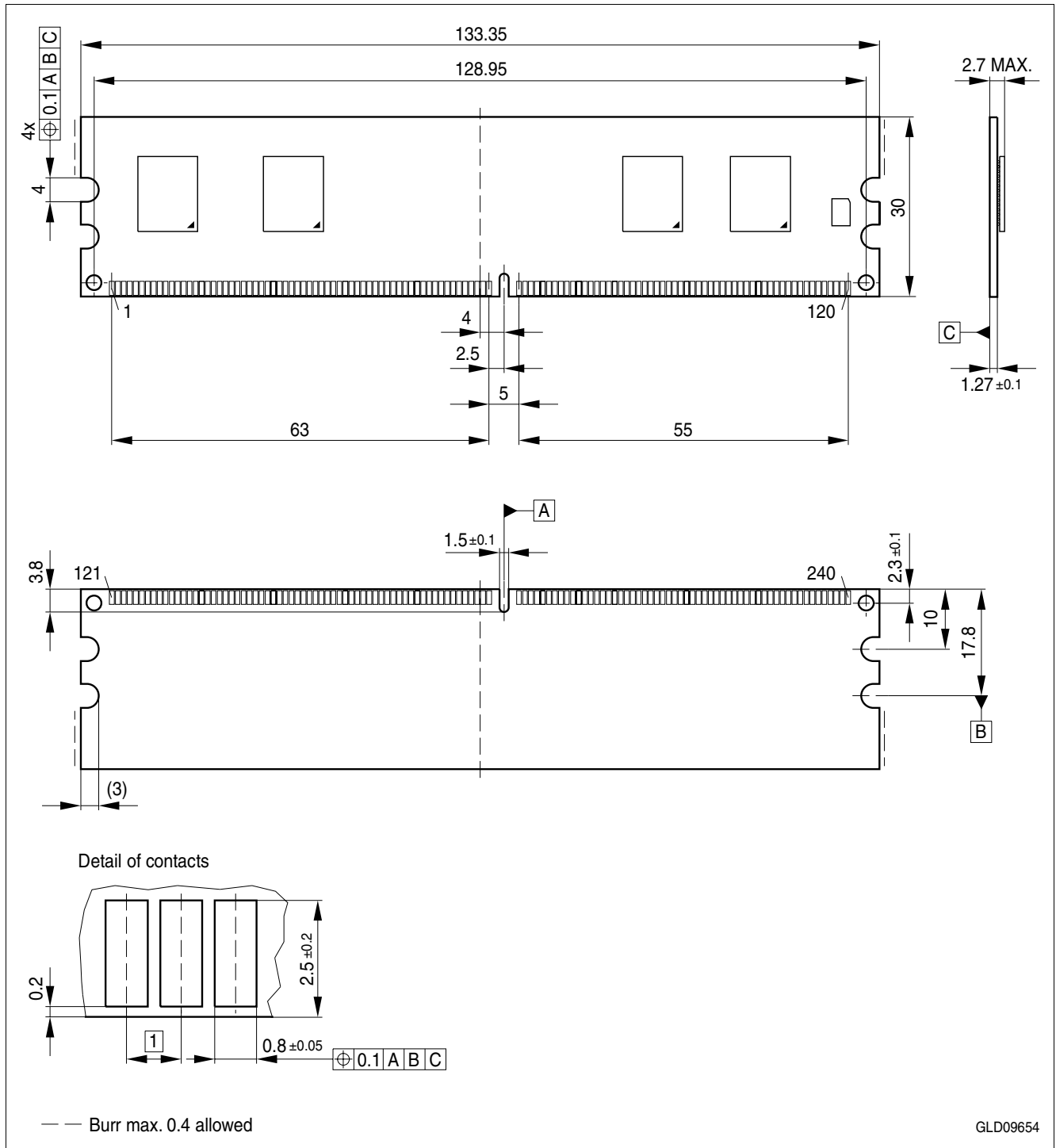


Figure 14 Package Outline Raw Card C – L-DIM-240-3

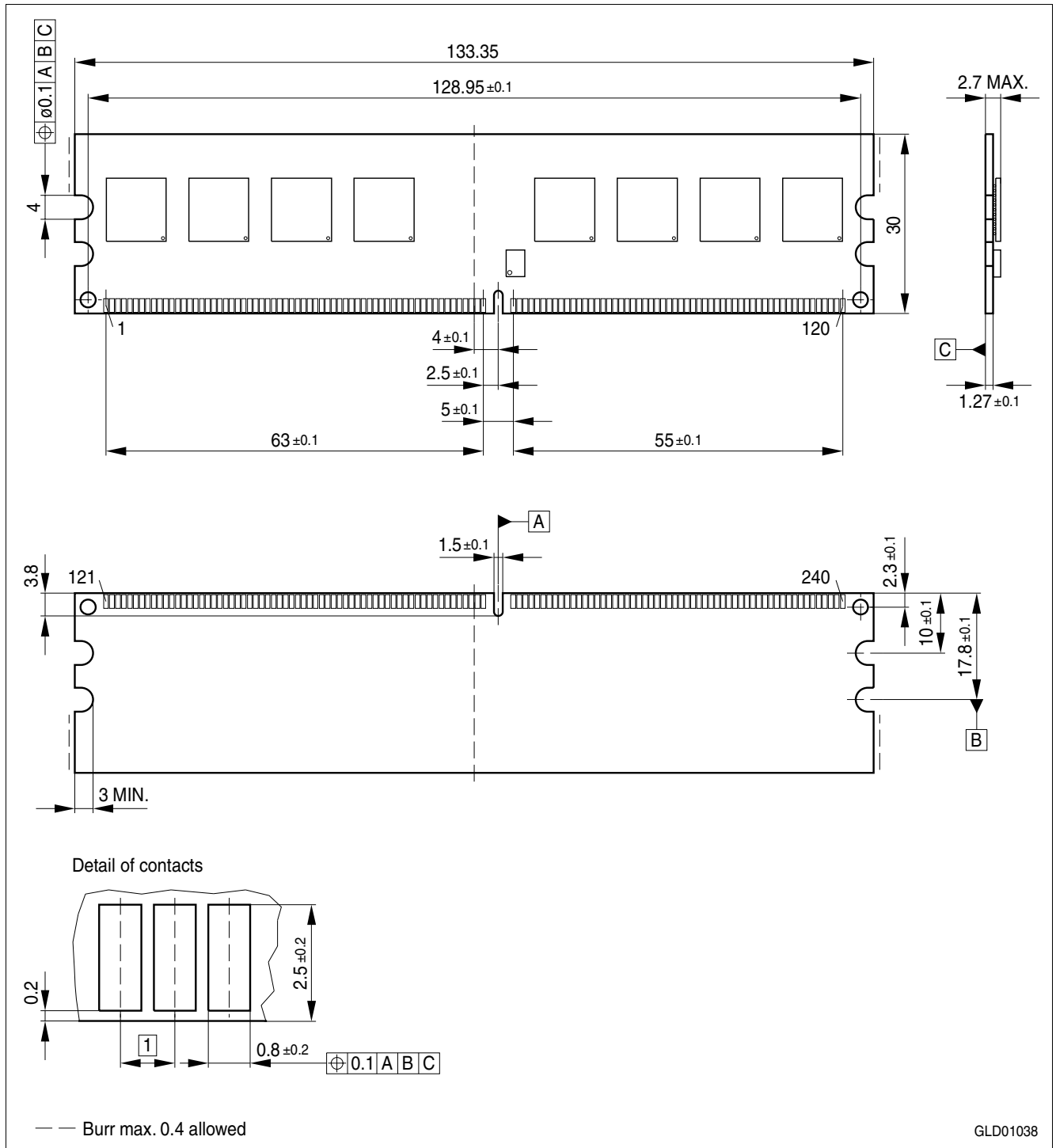


Figure 15 Package Outline Raw Card D L-DIM-240-8



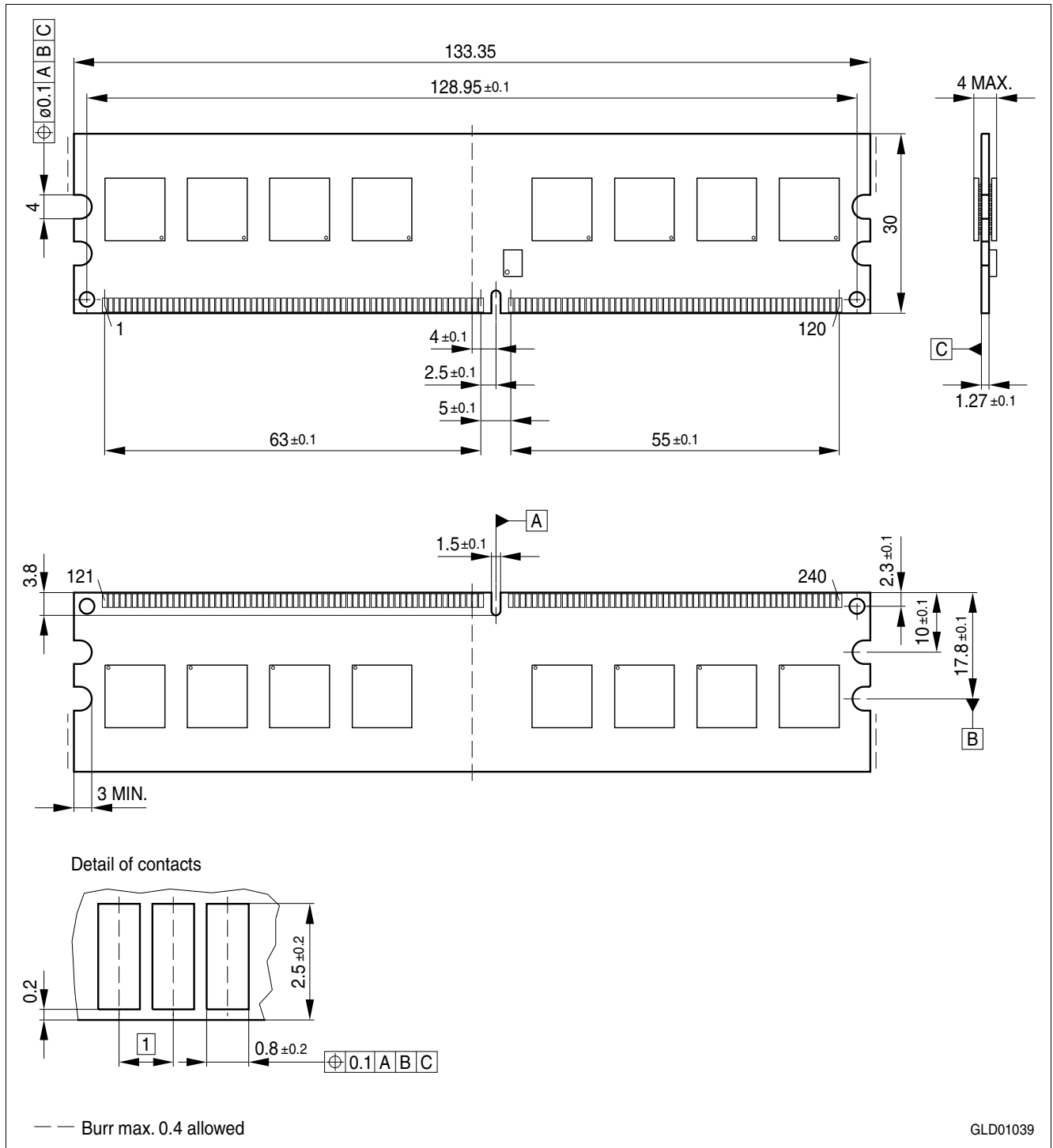


Figure 16 Package Outline Raw Card E L-DIM-240-9

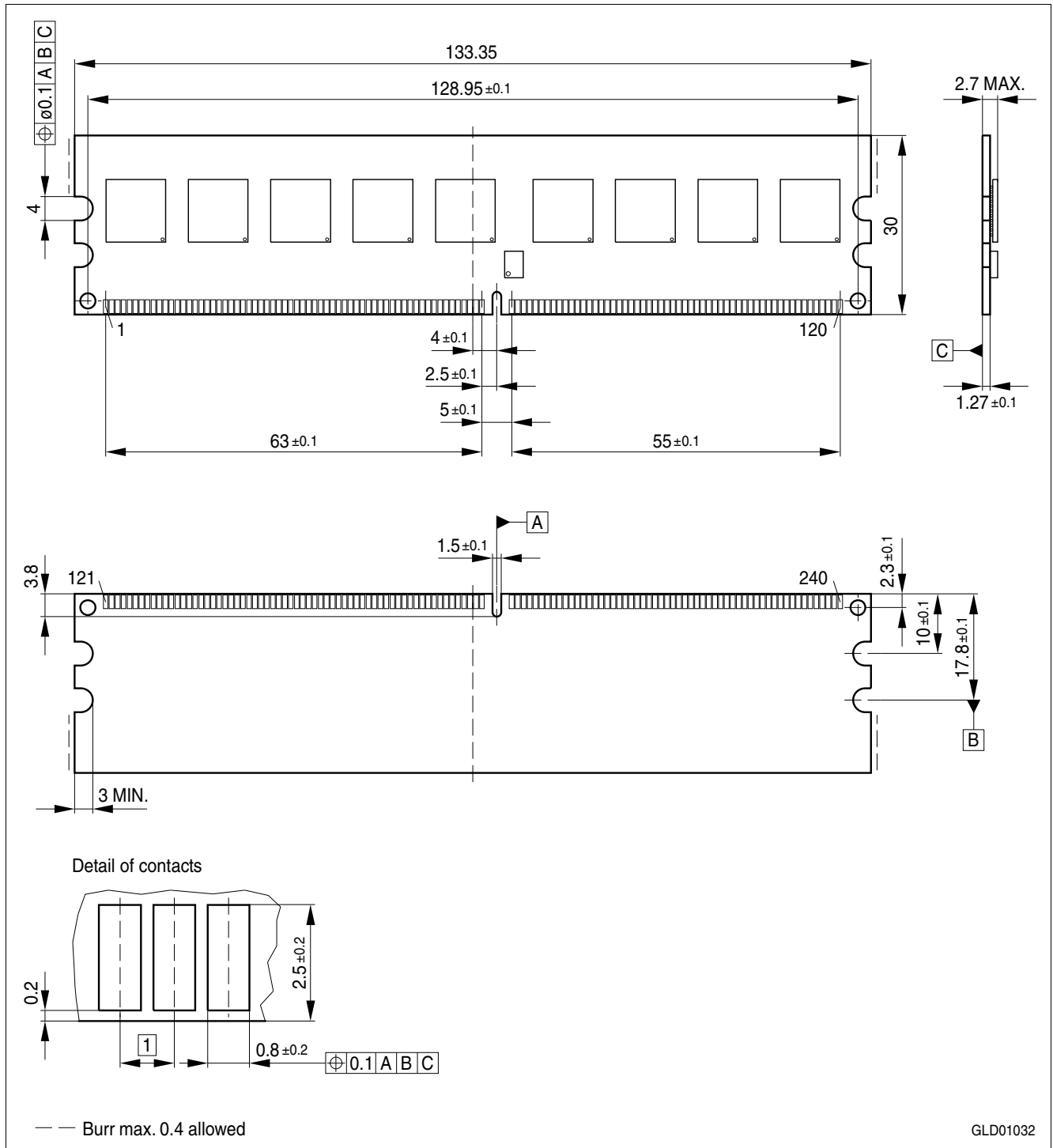
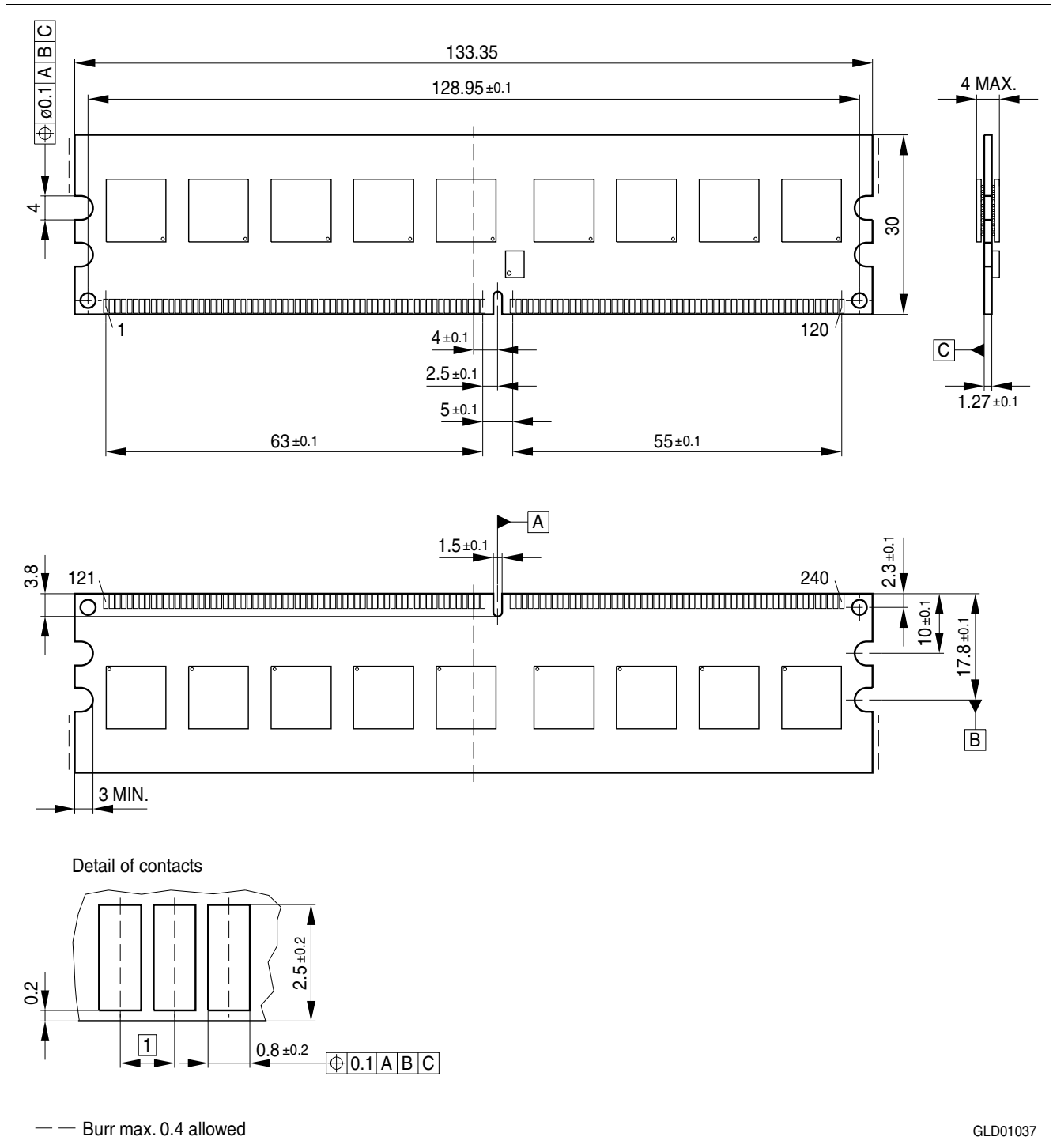


Figure 17 Package Outline Raw Card F L-DIM-240-6



**Figure 18 Package Outline Raw Card G L-DIM-240-7**

## 7 Product Type Nomenclature (DDR2 DRAMs and DIMMs)

Infineon's nomenclature uses simple coding combined with some proprietary coding. [Table 39](#) provides examples for module and component product type number as well as the field number. The detailed field description together with possible values and coding explanation is listed for modules in [Table 40](#) and for components in [Table 41](#).

**Table 39 Nomenclature Fields and Examples**

Example for	Field Number										
	1	2	3	4	5	6	7	8	9	10	11
Micro-DIMM	HYS	64	T	64	0	2	0	K	M	-5	-A
DDR2 DRAM	HYB	18	T	512	16		0	A	C	-5	

**Table 40 DDR2 DIMM Nomenclature**

Field	Description	Values	Coding
1	INFINEON Modul Prefix	HYS	Constant
2	Module Data Width [bit]	64	Non-ECC
		72	ECC
3	DRAM Technology	T	DDR2
4	Memory Density per I/O [Mbit]; Module Density <sup>1)</sup>	32	256 MByte
		64	512 MByte
		128	1 GByte
		256	2 GByte
		512	4 GByte
5	Raw Card Generation	0 .. 9	Look up table
6	Number of Module Ranks	0, 2, 4	1, 2, 4
7	Product Variations	0 .. 9	Look up table
8	Package, Lead-Free Status	A .. Z	Look up table
9	Module Type	D	SO-DIMM
		M	Micro-DIMM
		R	Registered
		U	Unbuffered
10	Speed Grade	-3	PC2-5300 4-4-4
		-3S	PC2-5300 5-5-5
		-3.7	PC2-4200 4-4-4
		-3.7F	PC2-4200 3-3-3
		-5	PC2-3200 3-3-3
11	Die Revision	-A	First
		-B	Second

- 1) Multiplying "Memory Density per I/O" with "Module Data Width" and dividing by 8 for Non-ECC and 9 for ECC modules gives the overall module memory density in MBytes as listed in column "Coding".

**Table 41 DDR2 DRAM Nomenclature**

Field	Description	Values	Coding
1	INFINEON Component Prefix	HYB	Constant
2	Interface Voltage [V]	18	SSTL1.8
3	DRAM Technology	T	DDR2
4	Component Density [Mbit]	256	256 Mbit
		512	512 Mbit
		1G	1 Gbit
		2G	2 Gbit
5+6	Number of I/Os	40	×4
		80	×8
		16	×16
7	Product Variations	0 .. 9	Look up table
8	Die Revision	A	First
		B	Second
9	Package, Lead-Free Status	C	FBGA, lead-containing
		F	FBGA, lead-free
10	Speed Grade	-3	DDR2-667 4-4-4
		-3S	DDR2-667 5-5-5
		-3.7	DDR2-533 4-4-4
		-3.7F	DDR2-533 3-3-3
		-5	DDR2-400 3-3-3
11	N/A for Components		

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