

HYS64T32000HDL-[3.7/5]-A
HYS64T64020HDL-[3.7/5]-A
HYS64T128021HDL-[3.7/5]-A

200-Pin SO-DIMM DDR2 SDRAM Modules

DDR2 SDRAM
RoHS Compliant

Memory Products



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

The information in this document is subject to change without notice.

Edition 2004-10

**Published by Infineon Technologies AG,
St.-Martin-Strasse 53,
81669 München, Germany**

**© Infineon Technologies AG 2004.
All Rights Reserved.**

Attention please!

The information herein is given to describe certain components and shall not be considered as a guarantee of characteristics.

Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (www.infineon.com).

Warnings

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

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, 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.

HYS64T32000HDL–[3.7/5]–A
HYS64T64020HDL–[3.7/5]–A
HYS64T128021HDL–[3.7/5]–A

200-Pin SO-DIMM DDR2 SDRAM Modules

DDR2 SDRAM
SO-DIMM SDRAM
RoHS Compliant

Memory Products



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

Revision History:	Rev. 1.0	2004-10
--------------------------	-----------------	----------------

Previous Revision:	Rev. 0.87	2003-06
--------------------	-----------	---------

Page	Subjects (major changes since last revision)
------	--

All	Layout and paragraph-order update
-----	-----------------------------------

20, 21	I_{DD} currents updated and final
--------	-------------------------------------

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.mp@infineon.com

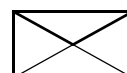


Table of Contents

1	Overview	6
1.1	Features	6
1.2	Description	7
2	Pin Configuration	8
2.1	Block Diagrams	15
3	I_{DD} Specifications and Conditions	18
3.1	I_{DD} Test Conditions	22
3.2	On Die Termination (ODT) Current	22
4	Electrical Characteristics	23
4.1	Operating Conditions	23
5	SPD Codes	27
6	Package Outlines	35
7	Product Type Nomenclature (DDR2 DRAMs and DIMMs)	38

200-Pin SO-DIMM DDR2 SDRAM Modules DDR2 SDRAM

HYS64T32000HDL–[3.7/5]–A
HYS64T64020HDL–[3.7/5]–A
HYS64T128021HDL–[3.7/5]–A

1 Overview

This chapter gives an overview of the 1.8 V Unbuffered 200-Pin SO-DIMM DDR2 SDRAM Modules product family and describes its main characteristics.

1.1 Features

- 200-Pin 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 and 128M × 64 module organization, and 32M × 16, 64M × 8 chip organization
- JEDEC standard Double-Data-Rate-Two Synchronous DRAMs (DDR2 SDRAM) with a single + 1.8 V (± 0.1 V) power supply
- Built with 512 Mb DDR2 SDRAMs in P-TFBGA-84, P-TFBGA-60 chipsize packages
- 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_18 compatible
- Off-Chip Driver Impedance Adjustment (OCD) and On-Die Termination (ODT)
- Serial Presence Detect with E²PROM
- SO-DIMM Dimensions (nominal): 30 mm high, 67.6 mm wide
- Based on JEDEC standard reference layouts Raw Card “A”, “C” and “D”
- RoHS Compliant Products¹⁾

Table 1 Performance

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⁾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.

1.2 Description

The INFINEON HYS64T[32/64/128]0xxHDL-[3.7/5]-A module family are Small Outline DIMM modules "SO-DIMMs" with 30,0 mm height based on DDR2 technology. DIMMs are available as non-ECC modules in 32M × 64 (256MB), 64M × 64 (512MB), 128M × 64 (1GB) organisation and density, intended for mounting into 200 pin connector sockets.

The memory array is designed with 512Mb 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 E²PROM device using the 2-pin I²C protocol. The first 128 bytes are programmed with configuration data and the second 128 bytes are available to the customer.

Table 2 Ordering Information for RoHS Compliant Products



Product Type ¹⁾	Compliance Code ²⁾	Description	SDRAM Technology
PC2-3200			
HYS64T32000HDL-5-A	256MB 1R×16 PC2-3200S-333-11-C0	1 rank, Non-ECC	512 Mbit (×16)
HYS64T64020HDL-5-A	512MB 2R×16 PC2-3200S-333-11-A0	2 ranks, Non-ECC	512 Mbit (×16)
HYS64T128021HDL-5-A	1GB 2R×8 PC2-3200S-333-11-D0	2 ranks, Non-ECC	512 Mbit (×8)
PC2-4200			
HYS64T32000HDL-3.7-A	256MB 1R×16 PC2-4200S-444-11-C0	1 rank, Non-ECC	512 Mbit (×16)
HYS64T64020HDL-3.7-A	512MB 2R×16 PC2-4200S-444-11-A0	2 ranks, Non-ECC	512 Mbit (×16)
HYS64T128021HDL-3.7-A	1GB 2R×8 PC2-4200S-444-11-F0	2 ranks, Non-ECC	512 Mbit (×8)

- 1) All part numbers end with a place code, designating the silicon die revision. Example: HYS64T32000HDL-5-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 "PC2-4200S-444-11-C1", where 4200S means SO-DIMM modules with 4.26 GB/sec Module Bandwidth and "444-11" 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 1.1 and produced on the Raw Card "C".

Table 3 Address Format

DIMM Density	Module Organization	Memory Ranks	ECC/ Non-ECC	# of SDRAMs	# of row/bank/columns bits	Raw Card
256 MByte	32M × 64	1	Non-ECC	4	13/2/10	C
512 MByte	64M × 64	2	Non-ECC	8	14/2/10	A
1 GByte	128M × 64	2	Non-ECC	16	14/2/10	F

Table 4 Components on Modules¹⁾

Product Type ²⁾	DRAM Components ²⁾	DRAM Density	DRAM Organisation
HYS64T32000HDL	HYB18T512160AF	512 Mbit	32M × 16
HYS64T64020HDL	HYB18T512160AF	512 Mbit	32M × 16
HYS64T128021HDL	HYB18T512800AF	512 Mbit	64Mb × 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 Configuration

The pin configuration of the Small Outline DDR2 SDRAM DIMM is listed by function in [Table 5](#) (200 pins). The abbreviations used in columns Pin and Buffer Type are explained in [Table 6](#) and [Table 7](#) respectively. The pin numbering is depicted in [Figure 1](#)

Table 5 Pin Configuration of SO-DIMM

Pin#	Name	Pin Type	Buffer Type	Function
Clock Signals				
30	CK0	I	SSTL	Clock Signals 2:0, Complement Clock Signals 2:0 <i>Note: 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{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.</i>
164	CK1	I	SSTL	
32	$\overline{CK0}$	I	SSTL	
166	$\overline{CK1}$	I	SSTL	
79	CKE0	I	SSTL	Clock Enable Rank 1:0
80	CKE1	I	SSTL	<i>Note: 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> <i>Note: 2 Ranks module</i>
	NC	NC	—	<i>Note: 1-rank module</i>
Control Signals				
110	$\overline{S0}$	I	SSTL	Chip Select Rank 1:0
115	$\overline{S1}$	I	SSTL	<i>Note: 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 $\overline{S0}$; Rank 1 is selected by $\overline{S1}$. Ranks are also called "Physical banks".</i> <i>Note: 2 Ranks module</i>
	NC	NC	—	
108	\overline{RAS}	I	SSTL	Row Address Strobe <i>Note: When sampled at the cross point of the rising edge of CK, and falling edge of \overline{CK}, \overline{RAS}, \overline{CAS} and \overline{WE} define the operation to be executed by the SDRAM.</i>
113	\overline{CAS}	I	SSTL	Column Address Strobe
109	\overline{WE}	I	SSTL	Write Enable
Address Signals				
107	BA0	I	SSTL	Bank Address Bus 2:0
106	BA1	I	SSTL	<i>Note: Selects which DDR2 SDRAM internal bank of four or eight is activated.</i>

Pin Configuration
Table 5 Pin Configuration of SO-DIMM (cont'd)

Pin#	Name	Pin Type	Buffer Type	Function
85	BA2	I	SSTL	Bank Address Bus 2 <i>Note: greater than 512Mb DDR2 SDRAMS</i>
	NC	I	SSTL	<i>Note: less than 1Gb DDR2 SDRAMS</i>
102	A0	I	SSTL	Address Bus 12:0 <i>Note: 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 \overline{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.</i>
101	A1	I	SSTL	
100	A2	I	SSTL	
99	A3	I	SSTL	
98	A4	I	SSTL	
97	A5	I	SSTL	
94	A6	I	SSTL	
92	A7	I	SSTL	
93	A8	I	SSTL	
91	A9	I	SSTL	
105	A10	I	SSTL	
	AP	I	SSTL	
90	A11	I	SSTL	
89	A12	I	SSTL	Address Signal 12 <i>Note: Module based on 256 Mbit or larger dies</i>
116	A13	I	SSTL	Address Signal 13 <i>Note: 1 Gbit based module</i>
	NC	NC	—	<i>Note: Module based on 512 Mbit or smaller dies</i>
Data Signals				
5	DQ0	I/O	SSTL	Data Bus 63:0 <i>Note: Data Input/Output pins</i>
7	DQ1	I/O	SSTL	
17	DQ2	I/O	SSTL	
19	DQ3	I/O	SSTL	
4	DQ4	I/O	SSTL	
6	DQ5	I/O	SSTL	
14	DQ6	I/O	SSTL	
16	DQ7	I/O	SSTL	
23	DQ8	I/O	SSTL	
25	DQ9	I/O	SSTL	
35	DQ10	I/O	SSTL	
37	DQ11	I/O	SSTL	
20	DQ12	I/O	SSTL	
22	DQ13	I/O	SSTL	
36	DQ14	I/O	SSTL	

Table 5 Pin Configuration of SO-DIMM (cont'd)

Pin#	Name	Pin Type	Buffer Type	Function
38	DQ15	I/O	SSTL	Data Bus 63:0
43	DQ16	I/O	SSTL	
45	DQ17	I/O	SSTL	
55	DQ18	I/O	SSTL	
57	DQ19	I/O	SSTL	
44	DQ20	I/O	SSTL	
46	DQ21	I/O	SSTL	
56	DQ22	I/O	SSTL	
58	DQ23	I/O	SSTL	
61	DQ24	I/O	SSTL	
63	DQ25	I/O	SSTL	
73	DQ26	I/O	SSTL	
75	DQ27	I/O	SSTL	
62	DQ28	I/O	SSTL	
64	DQ29	I/O	SSTL	
74	DQ30	I/O	SSTL	
76	DQ31	I/O	SSTL	
123	DQ32	I/O	SSTL	
125	DQ33	I/O	SSTL	
135	DQ34	I/O	SSTL	
137	DQ35	I/O	SSTL	
124	DQ36	I/O	SSTL	
126	DQ37	I/O	SSTL	
134	DQ38	I/O	SSTL	
136	DQ39	I/O	SSTL	
141	DQ40	I/O	SSTL	
143	DQ41	I/O	SSTL	
151	DQ42	I/O	SSTL	
153	DQ43	I/O	SSTL	
140	DQ44	I/O	SSTL	
142	DQ45	I/O	SSTL	
152	DQ46	I/O	SSTL	
154	DQ47	I/O	SSTL	
157	DQ48	I/O	SSTL	
159	DQ49	I/O	SSTL	
173	DQ50	I/O	SSTL	
175	DQ51	I/O	SSTL	
158	DQ52	I/O	SSTL	
160	DQ53	I/O	SSTL	
174	DQ54	I/O	SSTL	

Pin Configuration
Table 5 Pin Configuration of SO-DIMM (cont'd)

Pin#	Name	Pin Type	Buffer Type	Function
176	DQ55	I/O	SSTL	Data Bus 63:0
179	DQ56	I/O	SSTL	
181	DQ57	I/O	SSTL	
189	DQ58	I/O	SSTL	
191	DQ59	I/O	SSTL	
180	DQ60	I/O	SSTL	
182	DQ61	I/O	SSTL	
192	DQ62	I/O	SSTL	
194	DQ63	I/O	SSTL	
Data Strobe Signals				
13	DQS0	I/O	SSTL	Data Strobe Bus 7:0 Note: 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.
11	$\overline{DQS0}$	I/O	SSTL	
31	DQS1	I/O	SSTL	
29	$\overline{DQS1}$	I/O	SSTL	
51	DQS2	I/O	SSTL	
49	$\overline{DQS2}$	I/O	SSTL	
70	DQS3	I/O	SSTL	
68	$\overline{DQS3}$	I/O	SSTL	
131	DQS4	I/O	SSTL	
129	$\overline{DQS4}$	I/O	SSTL	
148	DQS5	I/O	SSTL	
146	$\overline{DQS5}$	I/O	SSTL	
169	DQS6	I/O	SSTL	
167	$\overline{DQS6}$	I/O	SSTL	
188	DQS7	I/O	SSTL	
186	$\overline{DQS7}$	I/O	SSTL	
Data Mask Signals				
10	DM0	I	SSTL	Data Mask Bus 7:0 Note: 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.
26	DM1	I	SSTL	
52	DM2	I	SSTL	
67	DM3	I	SSTL	
130	DM4	I	SSTL	
147	DM5	I	SSTL	
170	DM6	I	SSTL	
185	DM7	I	SSTL	
EEPROM				
197	SCL	I	CMOS	Serial Bus Clock Note: This signal is used to clock data into and out of the SPD EEPROM.

Pin Configuration

Table 5 Pin Configuration of SO-DIMM (cont'd)

Pin#	Name	Pin Type	Buffer Type	Function
195	SDA	I/O	OD	Serial Bus Data <i>Note: This is a bidirectional pin used to transfer data into or out of the SPD EEPROM. A resistor must be connected from SDA to to V_{DDSPD} on the motherboard to act as a pull-up.</i>
198	SA0	I	CMOS	Serial Address Select Bus 1:0
200	SA1	I	CMOS	<i>Note: Address pins used to select the Serial Presence Detect base address.</i>
Power Supplies				
1	V_{REF}	AI	—	I/O Reference Voltage <i>Note: Reference voltage for the SSTL-18 inputs.</i>
199	V_{DDSPD}	PWR	—	EEPROM Power Supply <i>Note: Power supplies for core, I/O, Serial Presence Detect, and ground for the module.</i>
81,82,87,88,95,96,103,104,111,112,117,118	V_{DD}	PWR	—	Power Supply <i>Note: Power supplies for core, I/O, Serial Presence Detect, and ground for the module.</i>
2,3,8,9,12,15,18,21,24,27,28,33,34,39,40,41,42,47,48,53,54,59,60,65,66,71,72,77,78,121,122,127,128,132,133,138,139,144,145,149,150,155,156,161,162,165,171,172,177,178,183,184,187,190,193,196	V_{SS}	GND	—	Ground Plane <i>Note: Power supplies for core, I/O, Serial Presence Detect, and ground for the module.</i>
Other Pins				
114	ODT0	I	SSTL	On-Die Termination Control 1:0
119	ODT1	I	SSTL	On-Die Termination Control 1 <i>Note: Asserts on-die termination for DQ, DM, DQS, and \overline{DQS} signals if enabled via the DDR2 SDRAM mode register.</i> <i>Note: 2 Rank modules</i>
	NC	NC	—	<i>Note: 1 Rank modules</i>
50,69,83,84,120,163,168	NC	NC	—	Not connected <i>Note: Pins not connected on Infineon SO-DIMMs</i>

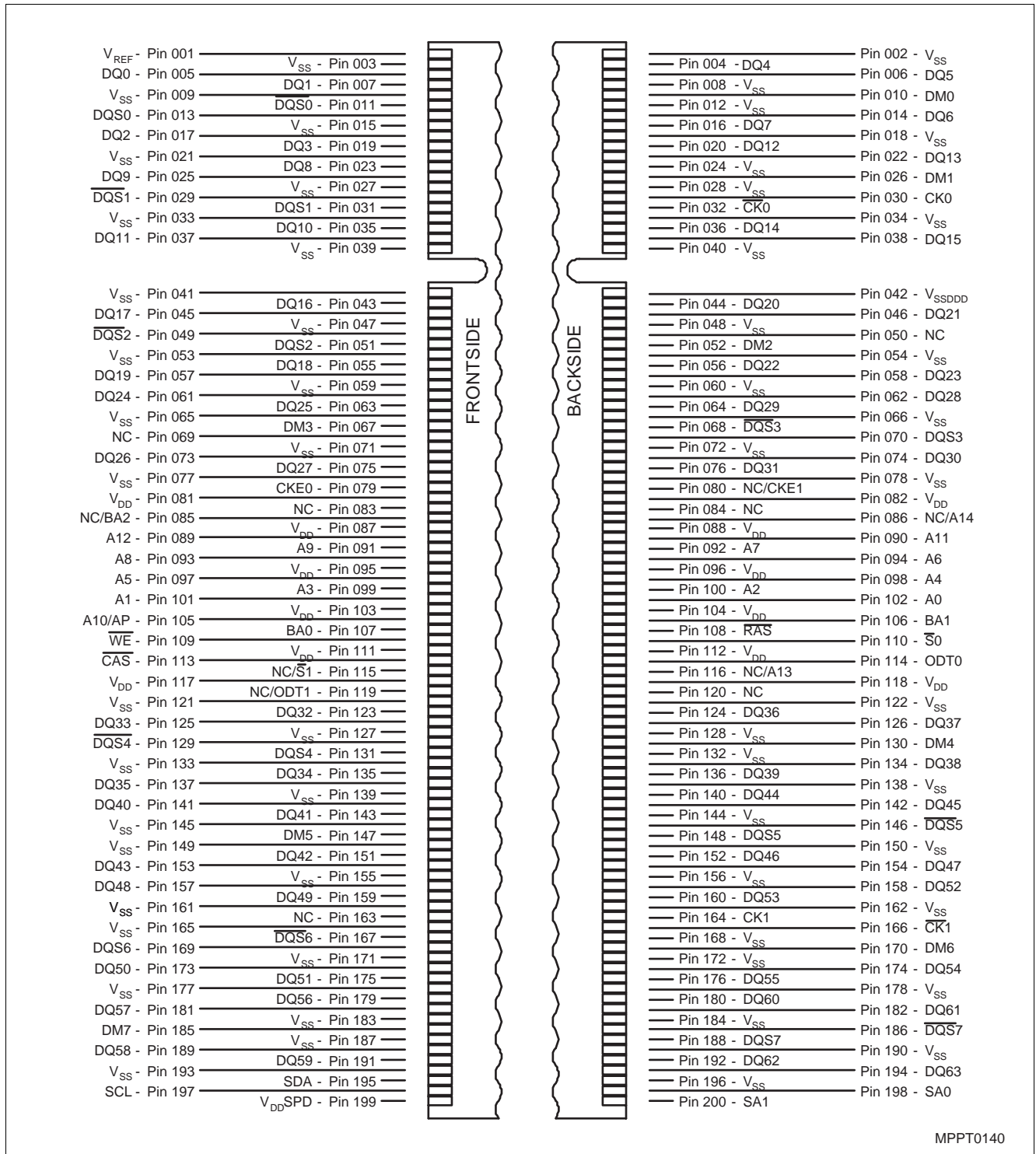
Table 6 Abbreviations for Pin Type

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 7 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 tristate, and allows multiple devices to share as a wire-OR.

Pin Configuration



MPPT0140

Figure 1 Pin Configuration SO-DIMM (200 Pin)

2.1 Block Diagrams

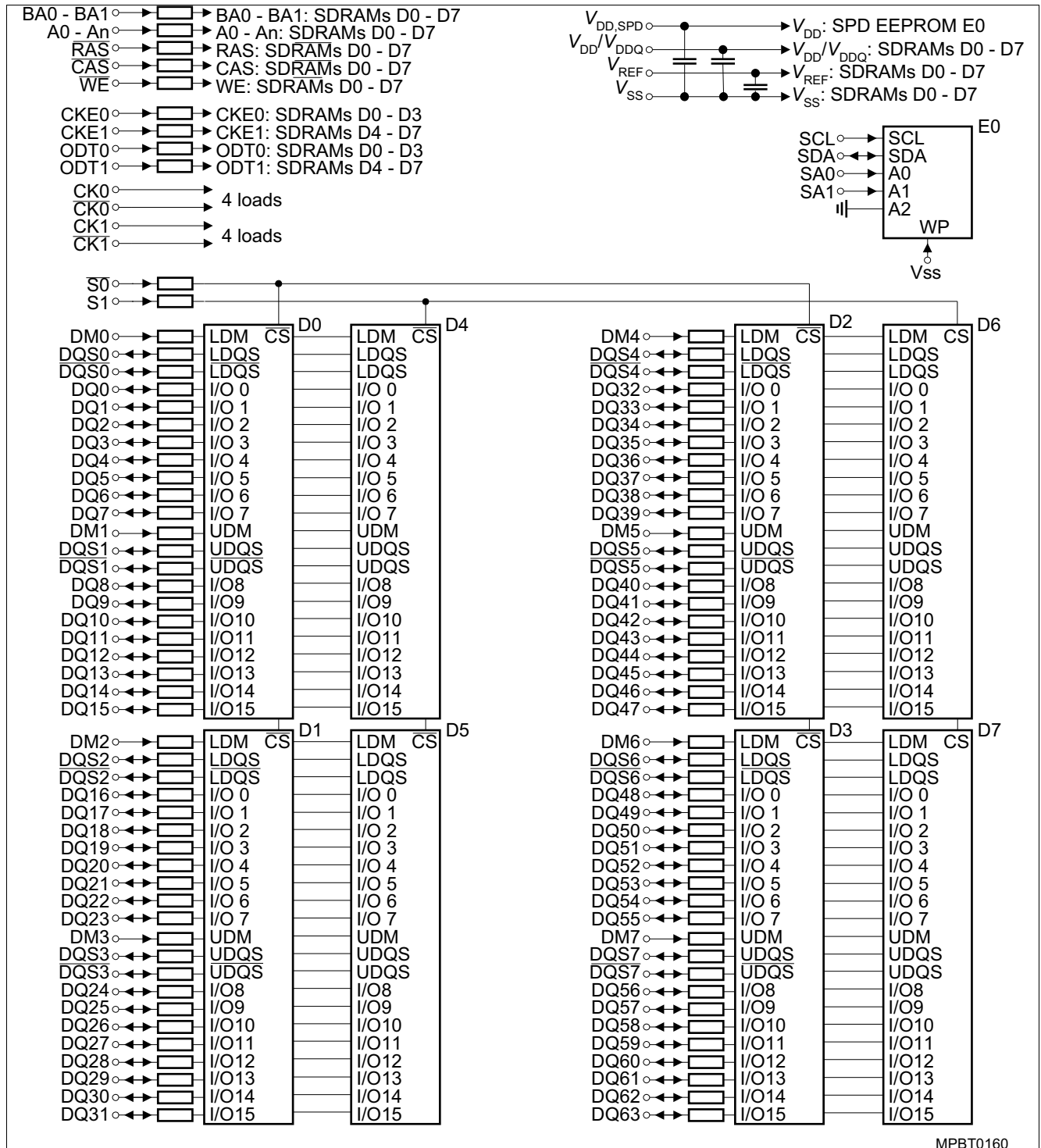


Figure 2 Block Diagram Raw Card A SO-DIMM (x64, 2 Ranks, x16)

Notes

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

2. $\overline{S0}$, $\overline{S1}$, $\overline{BA_n}$, $\overline{A_n}$, \overline{RAS} , \overline{CAS} , \overline{WE} , $\overline{ODT0}$, $\overline{ODT1}$, $\overline{CKE0}$, $\overline{CKE1}$ resistors are $3\ \Omega \pm 5\%$

Pin Configuration

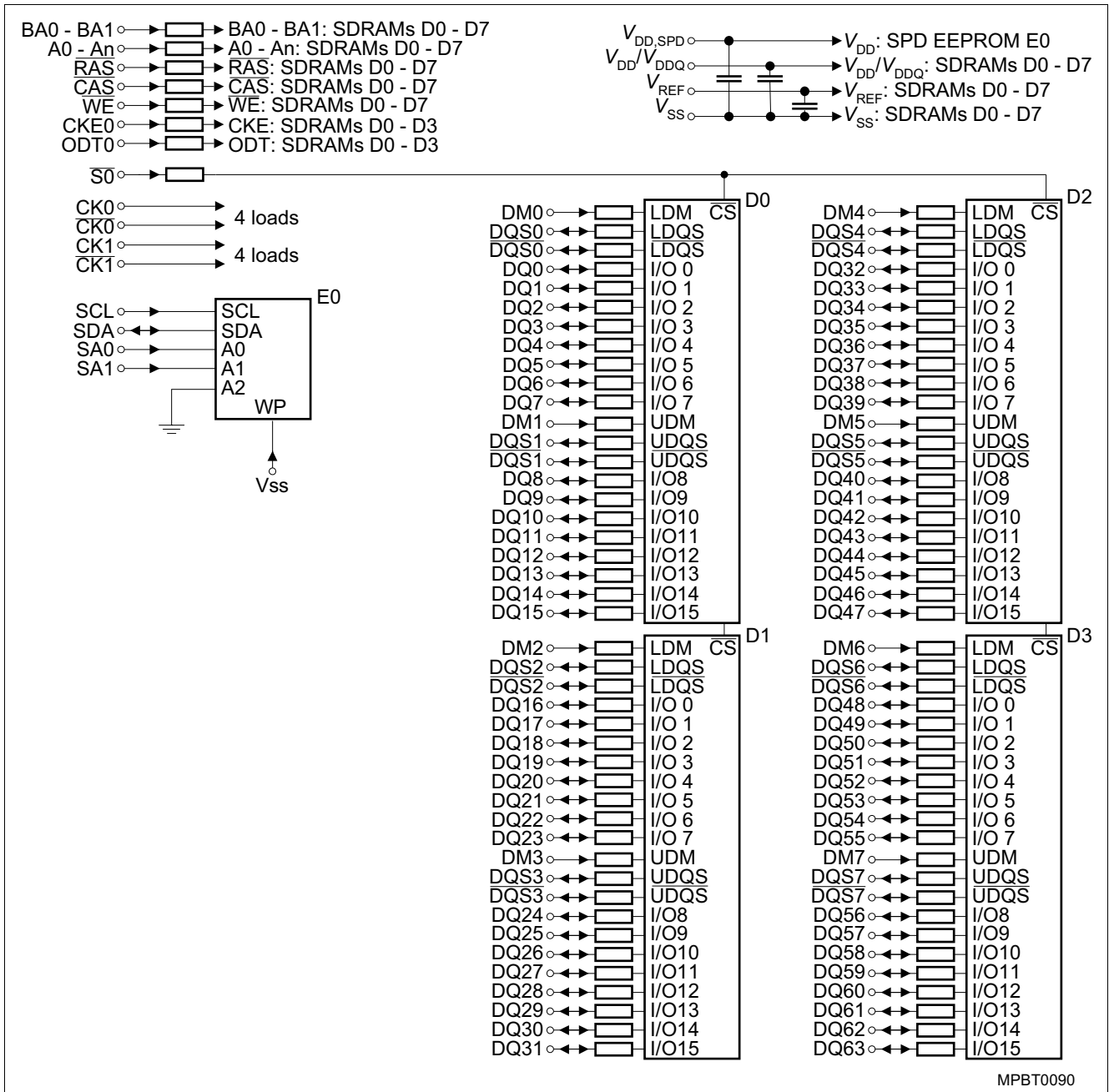


Figure 3 Block Diagram Raw Card C SO-DIMM (x64, 1Rank, x16)

Notes

1. DQ, DQS, DM resistors are $22\ \Omega \pm 5\%$
2. $\overline{S0}$, $\overline{S1}$, $\overline{BA_n}$, $\overline{A_n}$, \overline{RAS} , \overline{CAS} , \overline{WE} , $\overline{ODT0}$, $\overline{ODT1}$, $\overline{CKE0}$, $\overline{CKE1}$ resistors are $3\ \Omega \pm 5\%$

)

Pin Configuration

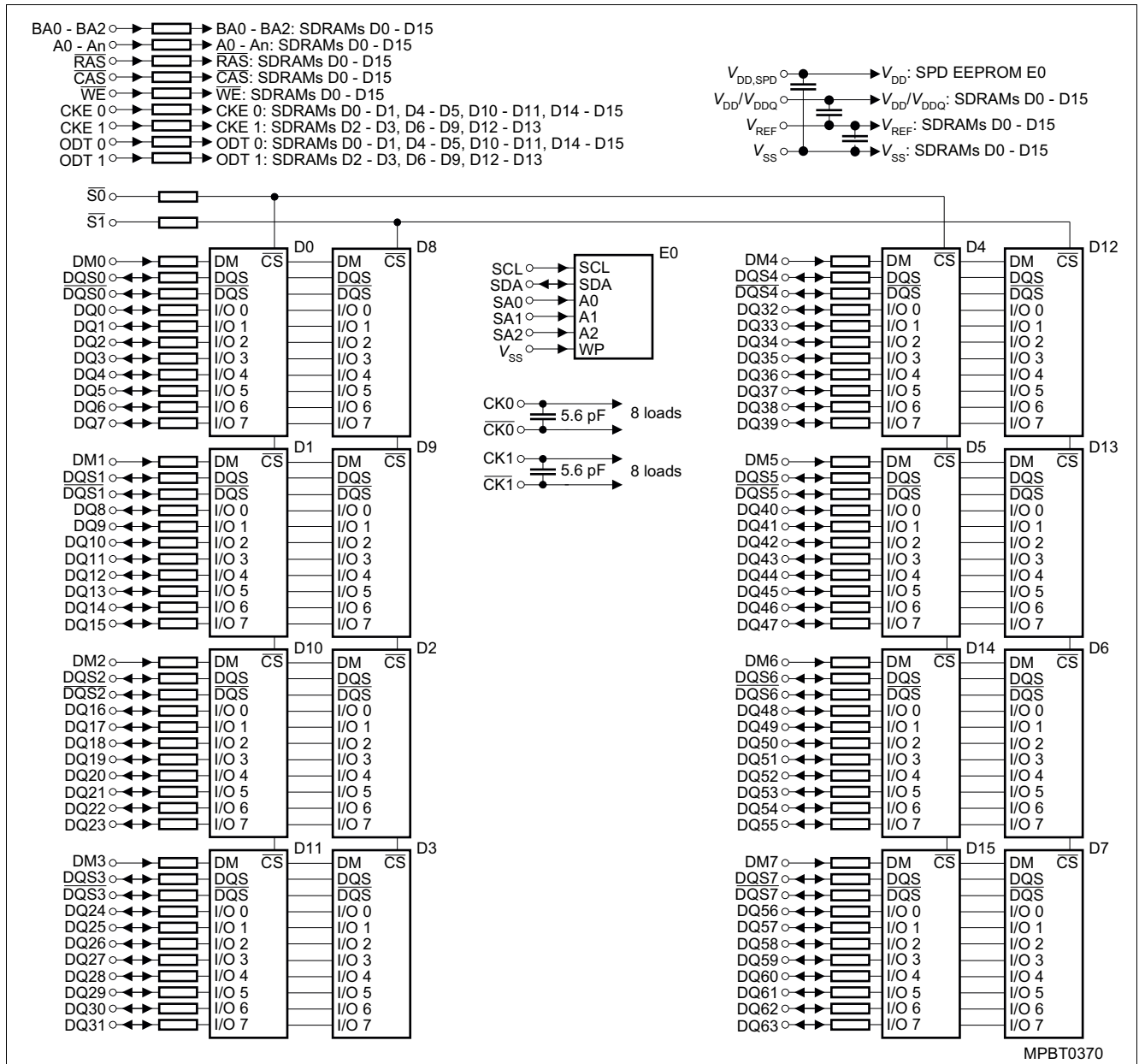


Figure 4 Block Diagram Raw Card F SO-DIMM (x64, 2 Ranks, x8)

Notes

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

4. $\overline{S0}$, $\overline{S1}$, $\overline{ODT0}$, $\overline{ODT1}$, $\overline{CKE0}$, $\overline{CKE1}$ resistors are $3 \Omega \pm 5 \%$

5. \overline{BAn} , \overline{An} , \overline{RAS} , \overline{CAS} , \overline{WE} resistors are $10 \Omega \pm 5 \%$

3 I_{DD} Specifications and Conditions

Table 8 I_{DD} Measurement Conditions ¹⁾²⁾³⁾⁴⁾⁵⁾⁶⁾

Parameter	Symbol
Operating Current 0 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}
Operating Current 1 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 _{MIN} ; CKE is HIGH, \overline{CS} is HIGH between valid commands. Address and control inputs are SWITCHING, Databus inputs are SWITCHING.	I_{DD1}
Precharge Standby Current 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}
Precharge Power-Down Current Other control and address inputs are STABLE, Data bus inputs are FLOATING.	I_{DD2P}
Precharge Quiet Standby Current 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}
Active Standby Current Burst Read: All banks open; Continuous burst reads; BL = 4; AL = 0, CL = CL _{MIN} ; $t_{CK} = t_{CK.MIN}$; $t_{RAS} = t_{RAS.MAX}$, $t_{RP} = t_{RP.MIN}$; 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}
Active Power-Down Current 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);	$I_{DD3P(0)}$
Active Power-Down Current 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);	$I_{DD3P(1)}$
Operating Current Burst Read: All banks open; Continuous burst reads; BL = 4; AL = 0, CL = CL _{MIN} ; $t_{CK} = t_{CK.MIN}$; $t_{RAS} = t_{RAS.MAX}$, $t_{RP} = t_{RP.MIN}$; CKE is HIGH, \overline{CS} is HIGH between valid commands. Address inputs are SWITCHING; Data Bus inputs are SWITCHING; $I_{OUT} = 0$ mA.	I_{DD4R}
Operating Current Burst Write: All banks open; Continuous burst writes; BL = 4; AL = 0, CL = CL _{MIN} ; $t_{CK} = t_{CK.MIN}$; $t_{RAS} = t_{RAS.MAX}$, $t_{RP} = t_{RP.MAX}$; CKE is HIGH, \overline{CS} is HIGH between valid commands. Address inputs are SWITCHING; Data Bus inputs are SWITCHING;	I_{DD4W}
Burst Refresh Current $t_{CK} = t_{CK.MIN}$, 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}
Distributed Refresh Current $t_{CK} = t_{CK.MIN}$, 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}

I_{DD} Specifications and Conditions

Table 8 **I_{DD} Measurement Conditions** (cont'd)¹⁾²⁾³⁾⁴⁾⁵⁾⁶⁾

Parameter	Symbol
Self-Refresh Current CKE ≤ 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}
All Bank Interleave Read Current 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) $V_{DDQ} = 1.8 \text{ V} \pm 0.1 \text{ V}$; $V_{DD} = 1.8 \text{ V} \pm 0.1 \text{ V}$
- 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} :
 LOW is defined as $V_{IN} \leq V_{IL(ac).MAX}$, HIGH is defined as $V_{IN} \geq V_{IH(ac).MIN}$
 STABLE is defined as: inputs are stable at a HIGH or LOW level
 FLOATING is defined as: inputs are $V_{REF} = V_{DDQ}/2$
 SWITCHING is defined as: 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.
- 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

I_{DD} Specifications and Conditions

Table 9 I_{DD} Specification

Product Type	HYS64T32000HDL-3.7-A	HYS64T64020HDL-3.7-A	HYS64T128021HD-3.7-A	Unit	Notes ¹⁾
Organization	256 MB	512 MB	1 GB		
	×64	×64	×64		
	1 Rank	2 Ranks	2 Ranks		
	-3.7	-3.7	-3.7		
Symbol	Max.	Max.	Max.		
I_{DD0}	320	340	550	mA	2)
I_{DD1}	360	380	630	mA	2)
I_{DD2N}	160	320	640	mA	3)
I_{DD2P}	20	30	60	mA	3)
I_{DD2Q}	120	240	480	mA	3)
I_{DD3N}	160	320	640	mA	3)
$I_{DD3P(MRS=0)}$	60	130	260	mA	3)
$I_{DD3P(MRS=1)}$	20	40	80	mA	3)
I_{DD4R}	400	420	750	mA	2)
I_{DD4W}	440	460	790	mA	2)
I_{DD5B}	520	540	1070	mA	2)
I_{DD5D}	20	50	100	mA	3)
I_{DD6}	8	16	32	mA	3)
I_{DD7}	880	900	1160	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} Pre charge Power-Down Standby Current mode

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

I_{DD} Specifications and Conditions
Table 10 I_{DD} Specification

Product Type	HYS64T32000HDL-5-A	HYS64T64020HDL-5-A	HYS64T128021HDL-5-A	Unit	Notes ¹⁾
Organization	256 MB	512 MB	1 GB		
	×64	×64	×64		
	1 Rank	2 Ranks	2 Ranks		
	-5	-5	-5		
Symbol	Max.	Max.	Max.		
I_{DD0}	280	300	470	mA	2)
I_{DD1}	300	320	510	mA	2)
I_{DD2N}	130	260	510	mA	3)
I_{DD2P}	20	30	60	mA	3)
I_{DD2Q}	100	200	400	mA	3)
I_{DD3N}	140	280	560	mA	3)
$I_{DD3P(MRS=0)}$	50	100	210	mA	3)
$I_{DD3P(MRS=1)}$	20	40	80	mA	3)
I_{DD4R}	340	360	590	mA	2)
I_{DD4W}	360	380	630	mA	2)
I_{DD5B}	480	500	990	mA	2)
I_{DD5D}	20	50	100	mA	3)
I_{DD6}	8	16	32	mA	3)
I_{DD7}	840	860	1070	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} Pre charge Power-Down Standby Current mode

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

3.1 I_{DD} Test Conditions

For testing the I_{DD} parameters, the following timing parameters are used:

Table 11 I_{DD} Measurement Test Conditions

Parameter	Symbol	–3.7	–5	Unit
		PC2-4200-4-4-4	PC2-3200-3-3-3	
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	×8 ¹⁾ t _{RRD(IDD)}	7.5	7.5	ns
	×16 ²⁾ t _{RRD(IDD)}	10	10	ns
Active to Precharge Command	t _{RAS.MIN(IDD)}	45	40	ns
	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	μs

1) For modules based on ×8 components

2) For modules based on ×16 components

3.2 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 tristate or driving 0 or 1, as long a ODT is enabled during a given period of time.

Table 12 ODT current per terminated pin:

Parameter	Symbol	Min.	Typ.	Max.	Unit	EMRS(1) State
Enabled ODT current per DQ added IDDQ current for ODT enabled; ODT is HIGH; Data Bus inputs are FLOATING	I _{ODTO}	5	6	7.5	mA/DQ	A6 = 0, A2 = 1
		2.5	3	3.75	mA/DQ	A6 = 1, A2 = 0
Active ODT current per DQ added IDDQ current for ODT enabled; ODT is HIGH; worst case of Data Bus inputs are STABLE or SWITCHING.	I _{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

4 Electrical Characteristics

4.1 Operating Conditions

Table 13 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

Table 14 Operating Conditions

Parameter	Symbol	Values		Unit	Notes
		min.	max.		
DIMM Module Operating Temperature Range (ambient)	T_{OPR}	0	+55	°C	
DRAM Component Case Temperature Range	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 specification 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.

Table 15 Supply Voltage Levels and DC Operating Conditions

Parameter	Symbol	Values			Unit	Notes
		Min.	Nom.	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 $0 V \leq V_{IN} \leq V_{DDQ} + 0.3 V$; all other pins at 0 V. Current is per pin

Electrical Characteristics
Table 16 Speed Grade Definition Speed Bins

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

- 1) 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. Timings are further guaranteed for normal OCD drive strength (EMRS(1) A1 = 0) only.
- 2) 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
- 3) Inputs are not recognized as valid until V_{REF} stabilizes. During the period before V_{REF} stabilizes, CKE = 0.2 x 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 17 Timing Parameter by Speed Grade - DDR2-400B & DDR2-533C

Parameter	Symbol	-3.7 DDR2-533 4-4-4		-5 DDR2-400 3-3-3		Unit	Notes ¹⁾
		Min.	Max.	Min.	Max.		
DQ output access time from CK / \overline{CK}	t_{AC}	-500	+500	-600	+600	ps	
CAS A to CAS B command period	t_{CCD}	2	—	2	—	t_{CK}	
CK, \overline{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, \overline{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)	$t_{DH}(base)$	225	—	275	—	ps	
DQ and DM input hold time (single ended data strobe)	$t_{DH1}(base)$	-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 / \overline{CK}	t_{DQSCK}	-450	+450	-500	+500	ps	

Electrical Characteristics
Table 17 Timing Parameter by Speed Grade - DDR2-400B & DDR2-533C (cont'd)

Parameter	Symbol	-3.7 DDR2-533 4-4-4		-5 DDR2-400 3-3-3		Unit	Notes ¹⁾
		Min.	Max.	Min.	Max.		
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 / \overline{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	
DQ low-impedance time from CK / \overline{CK}	$t_{LZ(DQ)}$	$2 \times t_{AC,MIN}$	$t_{AC,MAX}$	$2 \times t_{AC,MIN}$	$t_{AC,MAX}$	ps	
DQS low-impedance from CK / \overline{CK}	$t_{LZ(DQS)}$	$t_{AC,MIN}$	$t_{AC,MAX}$	$t_{AC,MIN}$	$t_{AC,MAX}$	ps	
Mode register set command cycle time	t_{MRD}	2	—	2	—	t_{CK}	
OCD drive mode output delay	t_{OIT}	0	12	0	12	ns	
Data output hold time from DQS	t_{QH}	$t_{HP} - t_{QHS}$	—	$t_{HPQ} - t_{QHS}$	—		
Data hold skew factor	t_{QHS}	—	400	—	450	ps	
Average periodic refresh Interval	t_{REFI}	—	7.8	—	7.8	μs	²⁾
		—	3.9	—	3.9	μs	³⁾
Auto-Refresh to Active/Auto-Refresh command period	t_{RFC}	105	—	105	—	ns	
Precharge-All (4 banks) command period	t_{RP}	$t_{RP} + 1t_{CK}$	—	$t_{RP} + 1t_{CK}$	—	ns	
Read preamble	t_{RPRE}	0.9	1.1	0.9	1.1	t_{CK}	
Read postamble	t_{RPST}	0.40	0.60	0.40	0.60	t_{CK}	
Active bank A to Active bank B command period	t_{RRD}	7.5	—	7.5	—	ns	
		10	—	10	—	ns	
Internal Read to Precharge command delay	t_{RTP}	7.5	—	7.5	—	ns	

Electrical Characteristics
Table 17 Timing Parameter by Speed Grade - DDR2-400B & DDR2-533C (cont'd)

Parameter	Symbol	-3.7 DDR2-533 4-4-4		-5 DDR2-400 3-3-3		Unit	Notes ¹⁾
		Min.	Max.	Min.	Max.		
Write preamble	t_{WPRE}	$0.35 \times t_{CK}$	—	$0.35 \times t_{CK}$	—	t_{CK}	
Write postamble	t_{WPST}	0.40	0.60	0.40	0.60	t_{CK}	
Write recovery time for write without Auto-Precharge	t_{WR}	15	—	15	—	ns	
Write recovery time for write with Auto-Precharge	WR	t_{WR}/t_{CK}		t_{WR}/t_{CK}		t_{CK}	
Internal Write to Read command delay	t_{WTR}	7.5	—	10	—	ns	
Exit power down to any valid command (other than NOP or Deselect)	t_{XARD}	2	—	2	—	t_{CK}	
Exit active power-down mode to Read command (slow exit, lower power)	t_{XARDS}	6 – AL	—	6 – AL	—	t_{CK}	
Exit precharge power-down to any valid command (other than NOP or Deselect)	t_{XP}	2	—	2	—	t_{CK}	
Exit Self-Refresh to non-Read command	t_{XSNR}	$t_{RFC} + 10$	—	$t_{RFC} + 10$	—	ns	
Exit Self-Refresh to Read command	t_{XSRD}	200	—	200	—	t_{CK}	

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

2) $0 \leq T_{CASE} \leq 85^\circ\text{C}$

3) $85^\circ\text{C} < T_{CASE} \leq 95^\circ\text{C}$

Table 18 ODT AC Electrical Characteristics and Operating Conditions

Symbol	Parameter / Condition	Values		Unit	Notes
		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} .

5 SPD Codes

Table 19 SPD Codes for HYS64T[32/64/128]0xxHDL-3.7-A

Product Type		HYS64T32000HDL-3.7-A	HYS64T64020HDL-3.7-A	HYS64T128021HDL-3.7-A
Organization		256 MB	512 MB	1 GByte
		×64	×64	×64
		1 Rank (×16)	2 Ranks (×16)	2 Ranks (×8)
Label Code		PC2-4200S-444	PC2-4200S-444	PC2-4200S-444
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX
0	Programmed SPD Bytes in EEPROM	80	80	80
1	Total number of Bytes in EEPROM	08	08	08
2	Memory Type (DDR2)	08	08	08
3	Number of Row Addresses	0D	0D	0E
4	Number of Column Addresses	0A	0A	0A
5	DIMM Rank and Stacking Information	60	61	61
6	Data Width	40	40	40
7	Not used	00	00	00
8	Interface Voltage Level	05	05	05
9	$t_{CK} @ CL_{MAX}$ (Byte 18) [ns]	3D	3D	3D
10	t_{AC} SDRAM @ CL_{MAX} (Byte 18) [ns]	50	50	50
11	Error Correction Support (non-ECC, ECC)	00	00	00
12	Refresh Rate and Type	82	82	82
13	Primary SDRAM Width	10	10	08
14	Error Checking SDRAM Width	00	00	00
15	Not used	00	00	00
16	Burst Length Supported	0C	0C	0C
17	Number of Banks on SDRAM Device	04	04	04
18	Supported CAS Latencies	38	38	38
19	DIMM Mechanical Characteristics	00	00	00
20	DIMM Type Information	04	04	04
21	DIMM Attributes	00	00	00
22	Component Attributes	01	01	01
23	$t_{CK} @ CL_{MAX} -1$ (Byte 18) [ns]	3D	3D	3D
24	t_{AC} SDRAM @ $CL_{MAX} -1$ [ns]	50	50	50

Table 19 SPD Codes for HYS64T[32/64/128]0xxHDL-3.7-A (cont'd)

Product Type		HYS64T32000HDL-3.7-A	HYS64T64020HDL-3.7-A	HYS64T128021HDL-3.7-A
Organization		256 MB	512 MB	1 GByte
		×64	×64	×64
		1 Rank (×16)	2 Ranks (×16)	2 Ranks (×8)
Label Code		PC2-4200S-444	PC2-4200S-444	PC2-4200S-444
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX
25	$t_{CK} @ CL_{MAX} -2$ (Byte 18) [ns]	50	50	50
26	t_{AC} SDRAM @ $CL_{MAX} -2$ [ns]	60	60	60
27	$t_{RP.MIN}$ [ns]	3C	3C	3C
28	$t_{RRD.MIN}$ [ns]	28	28	1E
29	$t_{RCD.MIN}$ [ns]	3C	3C	3C
30	$t_{RAS.MIN}$ [ns]	2D	2D	2D
31	Module Density per Rank	40	40	80
32	$t_{AS.MIN}$ and $t_{CS.MIN}$ [ns]	25	25	25
33	$t_{AH.MIN}$ and $t_{CH.MIN}$ [ns]	37	37	37
34	$t_{DS.MIN}$ [ns]	10	10	10
35	$t_{DH.MIN}$ [ns]	22	22	22
36	$t_{WR.MIN}$ [ns]	3C	3C	3C
37	$t_{WTR.MIN}$ [ns]	1E	1E	1E
38	$t_{RTP.MIN}$ [ns]	1E	1E	1E
39	Analysis Characteristics	00	00	00
40	t_{RC} and t_{RFC} Extension	00	00	00
41	$t_{RC.MIN}$ [ns]	3C	3C	3C
42	$t_{RFC.MIN}$ [ns]	69	69	69
43	$t_{CK.MAX}$ [ns]	80	80	80
44	$t_{DQSQ.MAX}$ [ns]	1E	1E	1E
45	$t_{QHS.MAX}$ [ns]	28	28	28
46	PLL Re-lock Time	00	00	00
47	$T_{CASE.MAX}$ Delta / ΔT_{4R4W} Delta	53	53	51
48	Psi(T-A) DRAM	72	72	78
49	ΔT_0 (DT0)	52	52	3E
50	ΔT_{2N} (DT2N, UDIMM) or ΔT_{2Q} (DT2Q, RDIMM)	2B	2B	2E
51	ΔT_{2P} (DT2P)	1D	1D	1E

Table 19 SPD Codes for HYS64T[32/64/128]0xxHDL–3.7–A (cont'd)

Product Type		HYS64T32000HDL–3.7–A	HYS64T64020HDL–3.7–A	HYS64T128021HDL–3.7–A
Organization		256 MB	512 MB	1 GByte
		×64	×64	×64
		1 Rank (×16)	2 Ranks (×16)	2 Ranks (×8)
Label Code		PC2–4200S–444	PC2–4200S–444	PC2–4200S–444
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX
52	ΔT_{3N} (DT3N)	1D	1D	1E
53	$\Delta T_{3P.fast}$ (DT3P fast)	23	23	24
54	$\Delta T_{3P.slow}$ (DT3P slow)	16	16	17
55	ΔT_{4R} (DT4R) / $\Delta T_{4R4W.S}$ Sign (DT4R4W)	36	36	34
56	ΔT_{5B} (DT5B)	1C	1C	1E
57	ΔT_7 (DT7)	30	30	20
58	Psi(ca) PLL	00	00	00
59	Psi(ca) REG	00	00	00
60	ΔT_{PLL} (DTPLL)	00	00	00
61	ΔT_{REG} (DTREG) / Toggle Rate	00	00	00
62	SPD Revision	11	11	11
63	Checksum of Bytes 0-62	BB	BC	D2
64	JEDEC ID Code of Infineon (1)	C1	C1	C1
65 -71	JEDEC ID Code of Infineon (2 - 8)	00	00	00
72	Module Manufacturer Location	xx	xx	xx
73	Product Type, Char 1	36	36	36
74	Product Type, Char 2	34	34	34
75	Product Type, Char 3	54	54	54
76	Product Type, Char 4	33	36	31
77	Product Type, Char 5	32	34	32
78	Product Type, Char 6	30	30	38
79	Product Type, Char 7	30	32	30
80	Product Type, Char 8	30	30	32
81	Product Type, Char 9	48	48	31
82	Product Type, Char 10	44	44	48
83	Product Type, Char 11	4C	4C	44
84	Product Type, Char 12	33	33	4C

Table 19 SPD Codes for HYS64T[32/64/128]0xxHDL-3.7-A (cont'd)

Product Type		HYS64T32000HDL-3.7-A	HYS64T64020HDL-3.7-A	HYS64T128021HDL-3.7-A
Organization		256 MB	512 MB	1 GByte
		×64	×64	×64
		1 Rank (×16)	2 Ranks (×16)	2 Ranks (×8)
Label Code		PC2-4200S-444	PC2-4200S-444	PC2-4200S-444
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX
85	Product Type, Char 13	2E	2E	33
86	Product Type, Char 14	37	37	2E
87	Product Type, Char 15	41	41	37
88	Product Type, Char 16	20	20	41
89	Product Type, Char 17	20	20	20
90	Product Type, Char 18	20	20	20
91	Module Revision Code	2x	2x	2x
92	Test Program Revision Code	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx
95 - 98	Module Serial Number (1 - 4)	xx	xx	xx
99 -127	Not used	00	00	00

Table 20 SPD Codes for HYS64T[32/64/128]0xxHDL-5-A

Product Type		HYS64T32000HDL-5-A	HYS64T64020HDL-5-A	HYS64T128021HDL-5-A
Organization		256 MB	512 MB	1 GByte
		×64	×64	×64
		1 Rank (×16)	2 Ranks (×16)	2 Ranks (×8)
Label Code		PC2-3200S-333	PC2-3200S-333	PC2-3200S-333
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX
0	Programmed SPD Bytes in EEPROM	80	80	80
1	Total number of Bytes in EEPROM	08	08	08
2	Memory Type (DDR2)	08	08	08
3	Number of Row Addresses	0D	0D	0E
4	Number of Column Addresses	0A	0A	0A
5	DIMM Rank and Stacking Information	60	61	61
6	Data Width	40	40	40
7	Not used	00	00	00
8	Interface Voltage Level	05	05	05
9	$t_{CK} @ CL_{MAX}$ (Byte 18) [ns]	50	50	50
10	t_{AC} SDRAM @ CL_{MAX} (Byte 18) [ns]	60	60	60
11	Error Correction Support (non-ECC, ECC)	00	00	00
12	Refresh Rate and Type	82	82	82
13	Primary SDRAM Width	10	10	08
14	Error Checking SDRAM Width	00	00	00
15	Not used	00	00	00
16	Burst Length Supported	0C	0C	0C
17	Number of Banks on SDRAM Device	04	04	04
18	Supported CAS Latencies	38	38	38
19	DIMM Mechanical Characteristics	00	00	00
20	DIMM Type Information	04	04	04
21	DIMM Attributes	00	00	00
22	Component Attributes	01	01	01
23	$t_{CK} @ CL_{MAX} -1$ (Byte 18) [ns]	50	50	50
24	t_{AC} SDRAM @ $CL_{MAX} -1$ [ns]	60	60	60
25	$t_{CK} @ CL_{MAX} -2$ (Byte 18) [ns]	50	50	50
26	t_{AC} SDRAM @ $CL_{MAX} -2$ [ns]	60	60	60

Table 20 SPD Codes for HYS64T[32/64/128]0xxHDL-5-A (cont'd)

Product Type		HYS64T32000HDL-5-A	HYS64T64020HDL-5-A	HYS64T128021HDL-5-A
Organization		256 MB	512 MB	1 GByte
		×64	×64	×64
		1 Rank (×16)	2 Ranks (×16)	2 Ranks (×8)
Label Code		PC2-3200S-333	PC2-3200S-333	PC2-3200S-333
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX
27	$t_{RP.MIN}$ [ns]	3C	3C	3C
28	$t_{RRD.MIN}$ [ns]	28	28	1E
29	$t_{RCD.MIN}$ [ns]	3C	3C	3C
30	$t_{RAS.MIN}$ [ns]	28	28	28
31	Module Density per Rank	40	40	80
32	$t_{AS.MIN}$ and $t_{CS.MIN}$ [ns]	35	35	35
33	$t_{AH.MIN}$ and $t_{CH.MIN}$ [ns]	47	47	47
34	$t_{DS.MIN}$ [ns]	15	15	15
35	$t_{DH.MIN}$ [ns]	27	27	27
36	$t_{WR.MIN}$ [ns]	3C	3C	3C
37	$t_{WTR.MIN}$ [ns]	28	28	28
38	$t_{RTP.MIN}$ [ns]	1E	1E	1E
39	Analysis Characteristics	00	00	00
40	t_{RC} and t_{RFC} Extension	00	00	00
41	$t_{RC.MIN}$ [ns]	37	37	37
42	$t_{RFC.MIN}$ [ns]	69	69	69
43	$t_{CK.MAX}$ [ns]	80	80	80
44	$t_{DQSQ.MAX}$ [ns]	23	23	23
45	$t_{QHS.MAX}$ [ns]	2D	2D	2D
46	PLL Re-lock Time	00	00	00
47	$T_{CASE.MAX}$ Delta / ΔT_{4R4W} Delta	51	51	51
48	Psi(T-A) DRAM	72	72	78
49	ΔT_0 (DT0)	42	42	32
50	ΔT_{2N} (DT2N, UDIMM) or ΔT_{2Q} (DT2Q, RDIMM)	23	23	24
51	ΔT_{2P} (DT2P)	1D	1D	1E
52	ΔT_{3N} (DT3N)	19	19	1B
53	$\Delta T_{3P.fast}$ (DT3P fast)	1C	1C	1E

Table 20 SPD Codes for HYS64T[32/64/128]0xxHDL–5–A (cont'd)

Product Type		HYS64T32000HDL–5–A	HYS64T64020HDL–5–A	HYS64T128021HDL–5–A
Organization		256 MB	512 MB	1 GByte
		×64	×64	×64
		1 Rank (×16)	2 Ranks (×16)	2 Ranks (×8)
Label Code		PC2–3200S–333	PC2–3200S–333	PC2–3200S–333
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX
54	$\Delta T_{3P.slow}$ (DT3P slow)	16	16	17
55	ΔT_{4R} (DT4R) / ΔT_{4R4W_S} Sign (DT4R4W)	2E	2E	28
56	ΔT_{5B} (DT5B)	1A	1A	1B
57	ΔT_7 (DT7)	2D	2D	1E
58	Psi(ca) PLL	00	00	00
59	Psi(ca) REG	00	00	00
60	ΔT_{PLL} (DTPLL)	00	00	00
61	ΔT_{REG} (DTREG) / Toggle Rate	00	00	00
62	SPD Revision	11	11	11
63	Checksum of Bytes 0-62	03	04	1C
64	JEDEC ID Code of Infineon (1)	C1	C1	C1
65 - 71	JEDEC ID Code of Infineon (2 - 8)	00	00	00
72	Module Manufacturer Location	xx	xx	xx
73	Product Type, Char 1	36	36	36
74	Product Type, Char 2	34	34	34
75	Product Type, Char 3	54	54	54
76	Product Type, Char 4	33	36	31
77	Product Type, Char 5	32	34	32
78	Product Type, Char 6	30	30	38
79	Product Type, Char 7	30	32	30
80	Product Type, Char 8	30	30	32
81	Product Type, Char 9	48	48	31
82	Product Type, Char 10	44	44	48
83	Product Type, Char 11	4C	4C	44
84	Product Type, Char 12	35	35	4C
85	Product Type, Char 13	41	41	35
86	Product Type, Char 14	20	20	41

Table 20 SPD Codes for HYS64T[32/64/128]0xxHDL-5-A (cont'd)

Product Type		HYS64T32000HDL-5-A	HYS64T64020HDL-5-A	HYS64T128021HDL-5-A
Organization		256 MB	512 MB	1 GByte
		×64	×64	×64
		1 Rank (×16)	2 Ranks (×16)	2 Ranks (×8)
Label Code		PC2-3200S-333	PC2-3200S-333	PC2-3200S-333
JEDEC SPD Revision		Rev. 1.1	Rev. 1.1	Rev. 1.1
Byte#	Description	HEX	HEX	HEX
87	Product Type, Char 15	20	20	20
88	Product Type, Char 16	20	20	20
89	Product Type, Char 17	20	20	20
90	Product Type, Char 18	20	20	20
91	Module Revision Code	2x	2x	2x
92	Test Program Revision Code	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx
95 - 98	Module Serial Number (1 - 4)	xx	xx	xx
99 - 127	Not used	00	00	00

6 Package Outlines

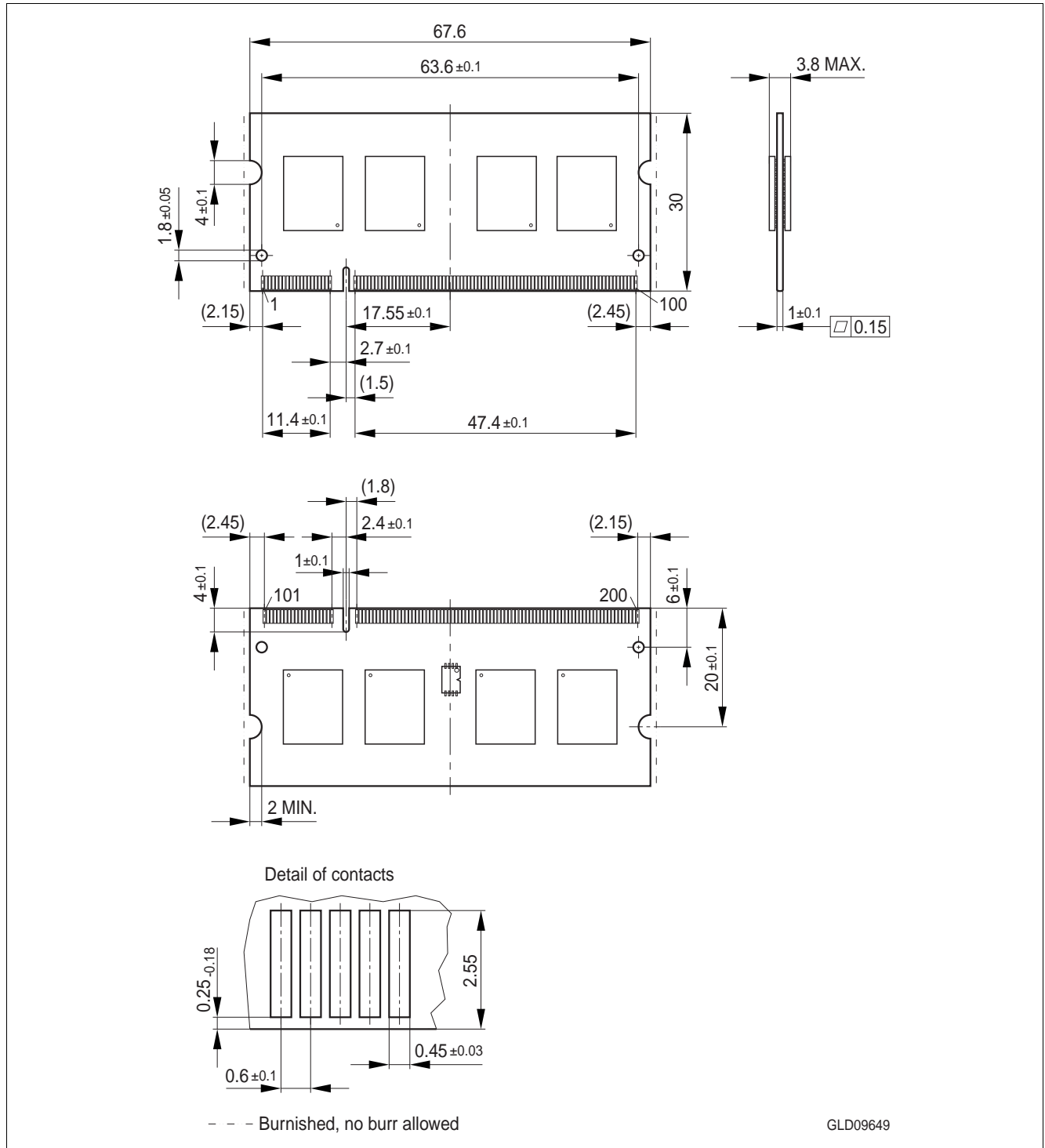


Figure 5 Package Outline Raw Card A L-DIM-200-31

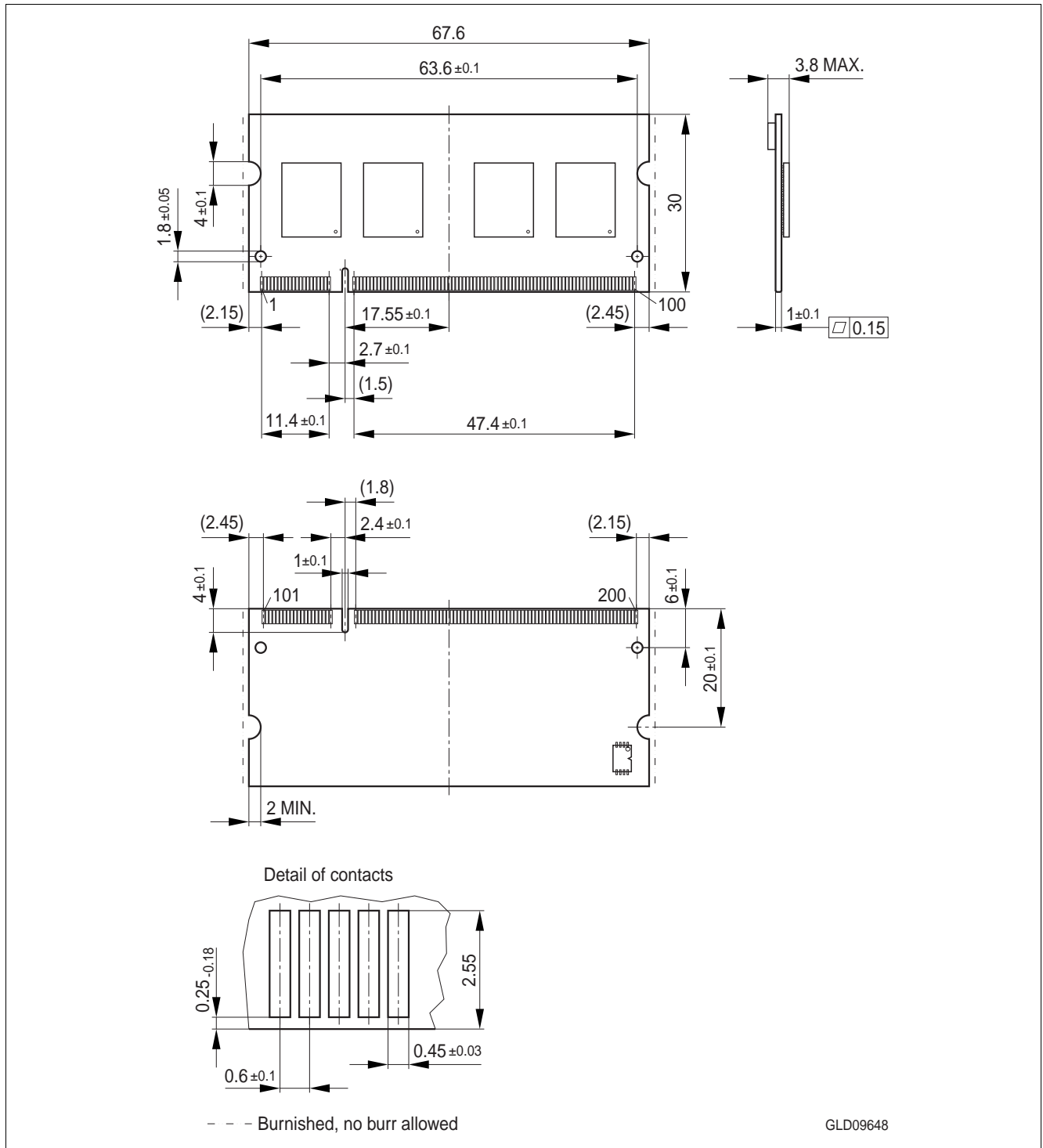


Figure 6 Package Outline Raw Card C L-DIM-200-30

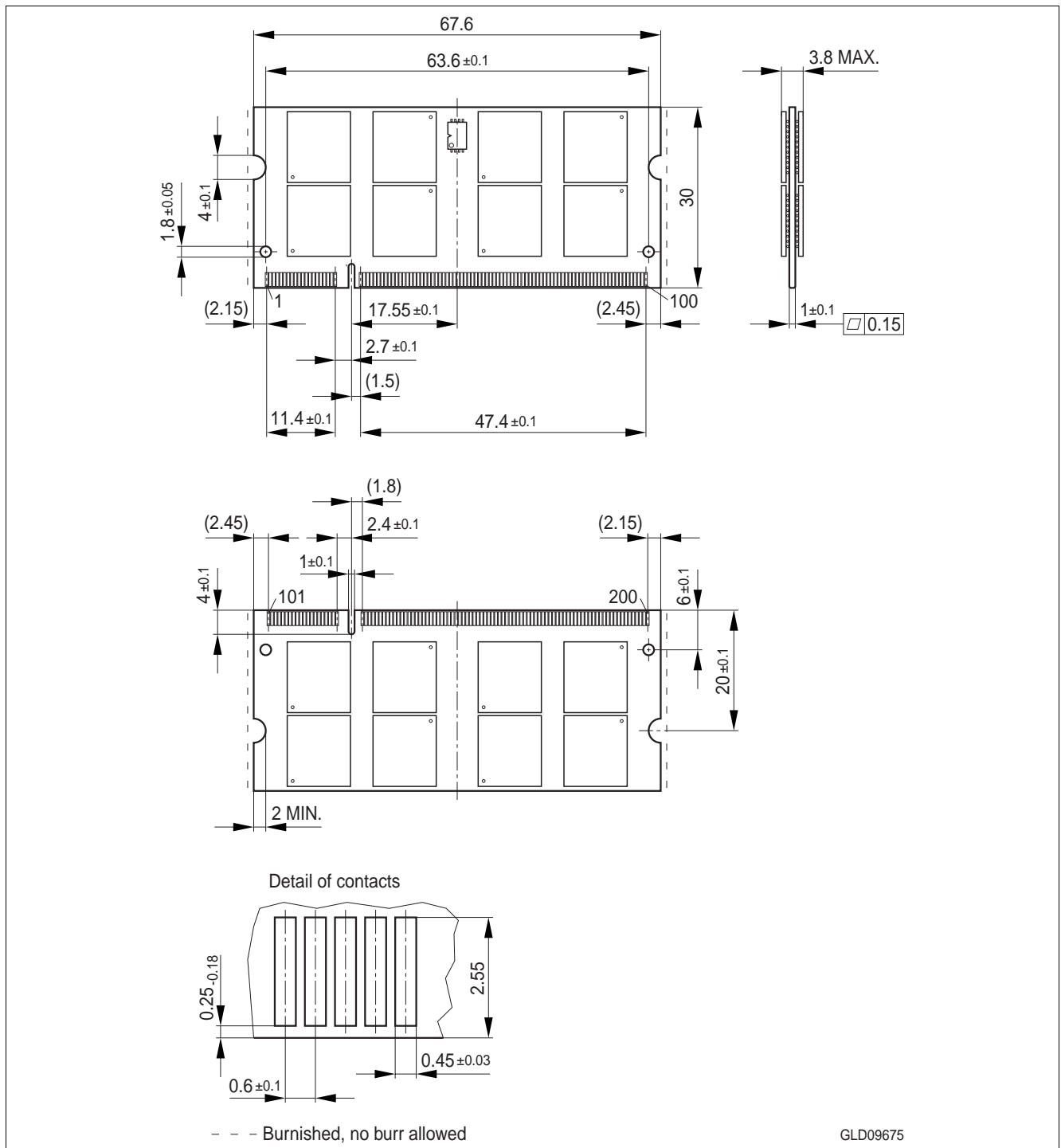


Figure 7 Package Outline Raw Card F - L-DIM-200-34

7 Product Type Nomenclature (DDR2 DRAMs and DIMMs)

Infineon's nomenclature uses simple coding combined with some proprietary coding. [Table 21](#) 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 22](#) and for components in [Table 23](#).

Table 21 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 22 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 ¹⁾	32	256 MByte
		64	512 MByte
		128	1 GByte
		256	2 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	–3.7	PC2–4200 4–4–4
		–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 23 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	–3.7	DDR2-533C
		–5	DDR2-400B
11	N/A for Components		

www.infineon.com

This datasheet has been download from:

www.datasheetcatalog.com

Datasheets for electronics components.