HYS64D128021[G/H]BDL–5–B
HYS64D128021[G/H]BDL–6–B

200-Pin Small Outline Dual-In-Line Memory Modules
SO-DIMM
DDR SDRAM
Green Product
Lead Containing Product

Memory Products

Infineon technologies

Never stop thinking.

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Page	Subjects (major changes since last revision)

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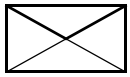


Table of Contents

1 Overview

1.1 Features

- Non-parity 200-Pin Small Outline Dual-In-Line Memory Modules
- Two ranks 128M × 64 organization
- Built with stacked 512 Mbit DDR SDRAMs dies in P–TFBGA–68 package
- JEDEC standard Double Data Rate Synchronous DRAMs (DDR SDRAM)
- Single +2.5 V (± 0.2 V) power supply and +2.6 V (± 0.2 V) power supply for DDR400
- Programmable CAS Latency, Burst Length, and Wrap Sequence (Sequential & Interleave)
- Auto Refresh (CBR) and Self Refresh
- All inputs and outputs SSTL_2 compatible
- Serial Presence Detect with E^2PROM
- Jedec standard form factor: 67.60 mm × 31.75 mm × 3.80 mm
- Gold plated contacts

Table 1 Performance

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

1.2 Description

The HYS64D128021[G/H]BDL–5–B and HYS64D128021[G/H]BDL–6–B are industry standard 200-Pin Small Outline Dual-In-Line Memory Modules (SO-DIMMs) organized as 128M × 64. The memory array is designed with Double Data Rate Synchronous DRAMs (DDR SDRAM). A variety of decoupling capacitors are mounted on the PC board. The DIMMs feature serial presence detect based on a serial E^2PROM device using the 2-pin I^2C protocol. The first 128 bytes are programmed with configuration data and the second 128 bytes are available to the customer

Table 2 Ordering Information

Type	Compliance Code	Description	SDRAM Technology
PC3200 (CL=3)			
HYS64D128021GBDL–5–B	PC3200S–3033–1–Z	two ranks 1 GB SO-DIMM	512 MBit (×8)
PC2700 (CL=2.5)			
HYS64D128021GBDL–6–B	PC2700S-2533–0–Z	two ranks 1 GB SO-DIMM	512 MBit (×8)
PC3200 (CL=3)			
HYS64D128021HBDL–5–B	PC3200S–3033–1–Z	two ranks 1 GB SO-DIMM	512 MBit (×8)
PC2700 (CL=2.5)			
HYS64D128021HBDL–6–B	PC2700S-2533–0–Z	two ranks 1 GB SO-DIMM	512 MBit (×8)

Note:

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

1) RCD: Row-Column-Delay

2 Pin Configuration

Table 3 Pin Definitions and Functions

Symbol	Type[1)]	Function
A0 - A12	I	Address Inputs
BA0, BA1	I	Bank Address
DQ0 - DQ63	I/O	Data Input/Output
$\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$	I	Command Input
CKE0 - CKE1	I	Clock Enable
DQS0 - DQS7	I/O	SDRAM Data Strobe
CK0 - CK1,	I	SDRAM Clock (true signal)
$\overline{CK0}$ - $\overline{CK1}$	I	SDRAM Clock (complementary signal)
DM0 - DM8	I	Data Mask
$\overline{S0}$, $\overline{S1}$ 2)	I	Chip Select
V_{DD}	PWR	Power (+ 2.5 V)
V_{SS}	GND	Ground
V_{DDQ}	PWR	I/O Driver power supply
V_{DDID}	PWR	VDD Indentification flag
V_{REF}	AI	I/O reference supply
V_{DDSPD}	PWR	Serial EEPROM power supply
SCL	I	Serial bus clock
SDA	I/O	Serial bus data line
SA0 - SA2	I	slave address select
NC	NC	Not Connected
NU	NU	Not Usable, reserved for future use

1) I: Input; O: Output; I/O: bidirectional In-/Output; AI: Analog Input; PWR: Power Supply; GND: Signal Ground; NC: Not Connected; NU: Not Usable

2) CKE1 and $\overline{S1}$ are used on two bank modules only

Table 4 Pin Configuration

Front side		Back side		Front side		Back side		Front side		Back side	
Pin #	Symbol	Pin #	Symbol	Pin #	Symbol	Pin #	Symbol	Pin #	Symbol	Pin #	Symbol
1	V_{REF}	2	V_{REF}	65	DQ26	66	DQ30	133	DQS4	134	DM4
3	V_{SS}	4	V_{SS}	67	DQ27	68	DQ31	135	DQ34	136	DQ38
5	DQ0	6	DQ4	69	V_{DD}	70	V_{DD}	137	V_{SS}	138	V_{SS}
7	DQ1	8	DQ5	71	(CB0)	72	(CB4)	139	DQ35	140	DQ39
9	V_{DD}	10	V_{DD}	73	(CB1)	74	(CB5)	141	DQ40	142	DQ44
11	DQS0	12	DM0	75	V_{SS}	76	V_{SS}	143	V_{DD}	144	V_{DD}
13	DQ2	14	DQ6	77	(DQS8)	78	(DM8)	145	DQ41	146	DQ45
15	V_{SS}	16	V_{SS}	79	(CB2)	80	(CB6)	147	DQS5	148	DM5
17	DQ3	18	DQ7	81	V_{DD}	82	V_{DD}	149	V_{SS}	150	V_{SS}
19	DQ8	20	DQ12	83	(CB3)	84	(CB7)	151	DQ42	152	DQ46
21	V_{DD}	22	V_{DD}	85	DU	86	DU	153	DQ43	154	DQ47
23	DQ9	24	DQ13	87	V_{SS}	88	V_{SS}	155	V_{DD}	156	V_{DD}
25	DQS1	26	DM1	89	(CK2)	90	V_{SS}	157	V_{DD}	158	$\overline{CK1}$
27	V_{SS}	28	V_{SS}	91	$\overline{(CK2)}$	92	V_{DD}	159	V_{SS}	160	CK1
29	DQ10	30	DQ14	93	V_{DD}	94	V_{DD}	161	V_{SS}	162	V_{SS}
31	DQ11	32	DQ15	95	CKE1	96	CKE0	163	DQ48	164	DQ52
33	V_{DD}	34	V_{DD}	97	DU	98	DU	165	DQ49	166	DQ53
35	CK0	36	V_{DD}	99	A12	100	A11	167	V_{DD}	168	V_{DD}
37	$\overline{CK0}$	38	V_{SS}	101	A9	102	A8	169	DQS6	170	DM6
39	V_{SS}	40	V_{SS}	103	V_{SS}	104	V_{SS}	171	DQ50	172	DQ54
Key				105	A7	106	A6	173	V_{SS}	174	V_{SS}
				107	A5	108	A4	175	DQ51	176	DQ55
41	DQ16	42	DQ20	109	A3	110	A2	177	DQ56	178	DQ60
43	DQ17	44	DQ21	111	A1	112	A0	179	V_{DD}	180	V_{DD}
45	V_{DD}	46	V_{DD}	113	V_{DD}	114	V_{DD}	181	DQ57	182	DQ61
47	DQS2	48	DM2	115	A10/AP	116	BA1	183	DQS7	184	DM7
49	DQ18	50	DQ22	117	BA0	118	$\overline{RAS}$	185	V_{SS}	186	V_{SS}
51	V_{SS}	52	V_{SS}	119	$\overline{WE}$	120	$\overline{CAS}$	187	DQ58	188	DQ62
53	DQ19	54	DQ23	121	$\overline{S0}$	122	$\overline{S1}$	189	DQ59	190	DQ63
55	DQ24	56	DQ28	123	DU	124	DU	191	V_{DD}	192	V_{DD}
57	V_{DD}	58	V_{DD}	125	V_{SS}	126	V_{SS}	193	SDA	194	SA0
59	DQ25	60	DQ29	127	DQ32	128	DQ36	195	SCL	196	SA1
61	DQS3	62	DM3	129	DQ33	130	DQ37	197	V_{DDSPD}	198	SA2
63	V_{SS}	64	V_{SS}	131	V_{DD}	132	V_{DD}	199	V_{DDID}	200	DU

Table 5 Address Format

Density	Organization	Memory Ranks	SDRAMs	# of SDRAMs	# of row/bank/ columns bits	Refresh	Period	Interval
1GB	128M × 64	2	64M × 8	16	13/2/11	8K	64 ms	7.8 µs

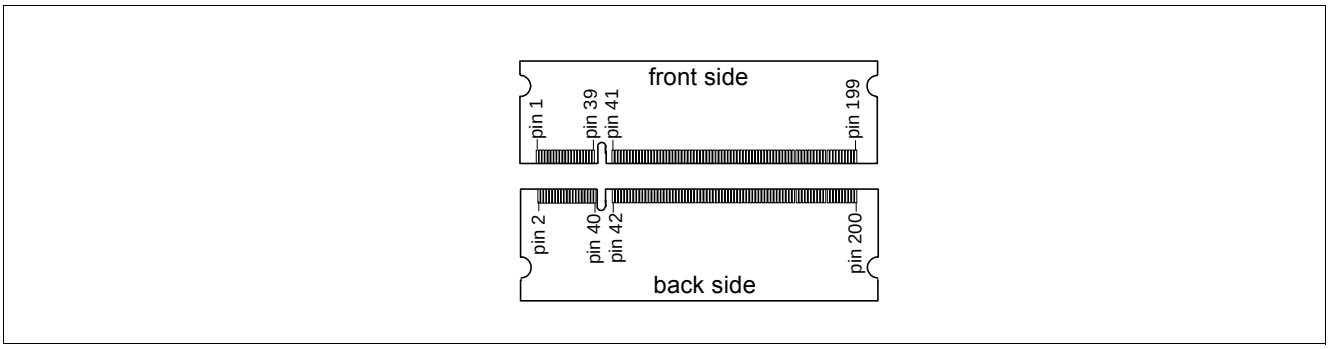
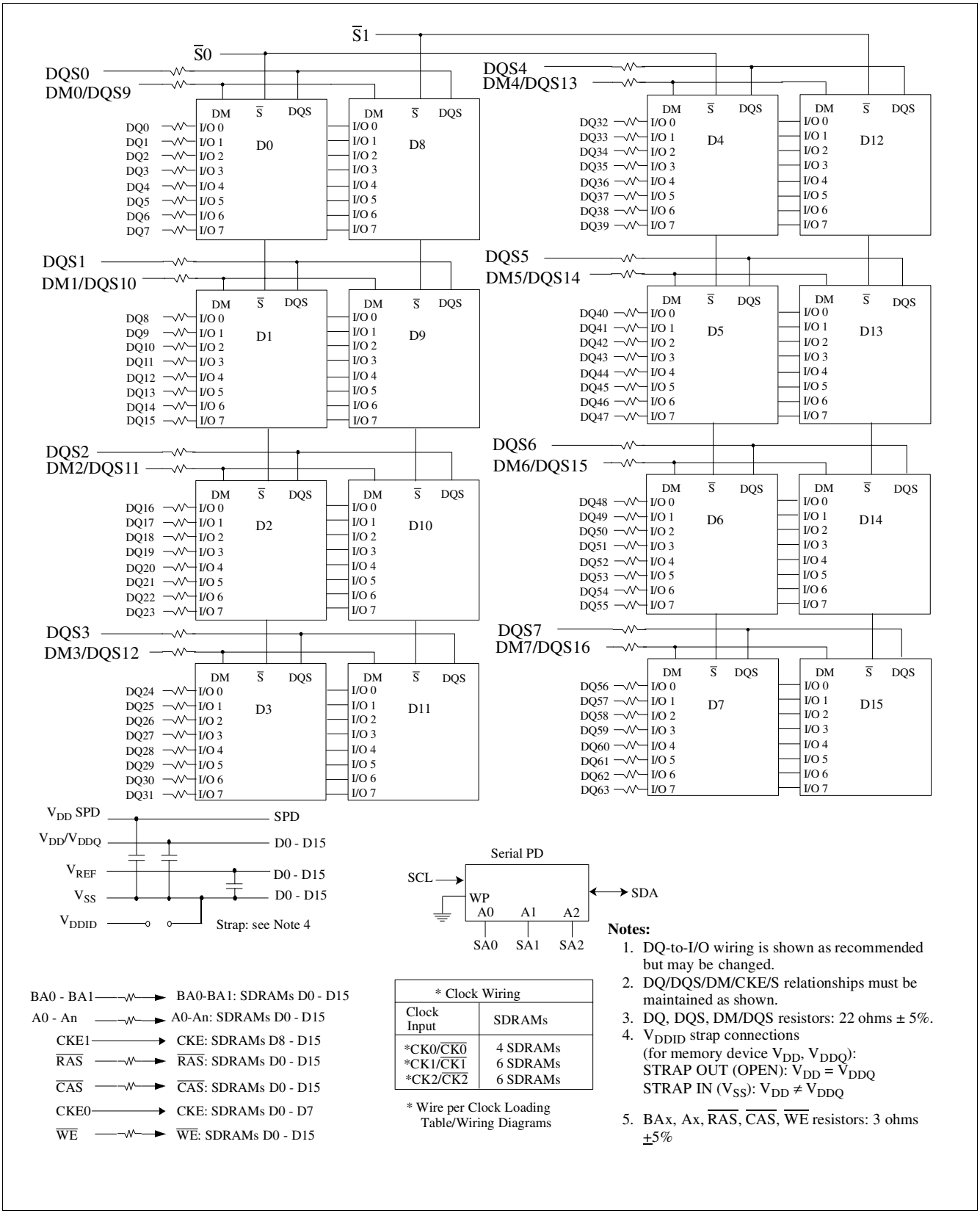


Figure 1 Pin Configuration



* Clock Wiring	
Clock Input	SDRAMs
*CK0/CK0	4 SDRAMs
*CK1/CK1	6 SDRAMs
*CK2/CK2	6 SDRAMs

* Wire per Clock Loading Table/Wiring Diagrams

Notes:

1. DQ-to-I/O wiring is shown as recommended but may be changed.
2. DQ/DQS/DM/CKE/S relationships must be maintained as shown.
3. DQ, DQS, DM/DQS resistors: 22 ohms ± 5%.
4. V_{DDID} strap connections (for memory device V_{DD}, V_{DDQ}): STRAP OUT (OPEN): $V_{DD} = V_{DDQ}$ STRAP IN (V_{SS}): $V_{DD} \neq V_{DDQ}$
5. BAx, Ax, RAS, CAS, WE resistors: 3 ohms ±5%

Figure 2 Block Diagram - 2 Ranks 128M × 64 DDR SDRAM SO-DIMM HYS64D128021[H/G]BDL–[5/6]–B

3 Electrical Characteristics

3.1 Operating Conditions

Table 6 Absolute Maximum Ratings

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

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

Table 7 Electrical Characteristics and DC Operating Conditions

Parameter	Symbol	Values			Unit	Note/Test Condition [1]
		Min.	Typ.	Max.		
Device Supply Voltage	V_{DD}	2.3	2.5	2.7	V	$f_{CK} \leq 166$ MHz
Device Supply Voltage	V_{DD}	2.5	2.6	2.7	V	$f_{CK} > 166$ MHz [2]
Output Supply Voltage	V_{DDQ}	2.3	2.5	2.7	V	$f_{CK} \leq 166$ MHz [3]
Output Supply Voltage	V_{DDQ}	2.5	2.6	2.7	V	$f_{CK} > 166$ MHz [2)3)]
EEPROM supply voltage	V_{DDSPD}	2.3	2.5	3.6	V	—
Supply Voltage, I/O Supply Voltage	V_{SS}, V_{SSQ}	0		0	V	—
Input Reference Voltage	V_{REF}	0.49 × V_{DDQ}	0.5 × V_{DDQ}	0.51 × V_{DDQ}	V	[4]
I/O Termination Voltage (System)	V_{TT}	V_{REF} – 0.04		V_{REF} + 0.04	V	[5]
Input High (Logic1) Voltage	$V_{IH(DC)}$	V_{REF} + 0.15		V_{DDQ} + 0.3	V	[8]
Input Low (Logic0) Voltage	$V_{IL(DC)}$	–0.3		V_{REF} – 0.15	V	[8]
Input Voltage Level, CK and $\overline{CK}$ Inputs	$V_{IN(DC)}$	–0.3		V_{DDQ} + 0.3	V	[8]
Input Differential Voltage, CK and $\overline{CK}$ Inputs	$V_{ID(DC)}$	0.36		V_{DDQ} + 0.6	V	[8)6)]
VI-Matching Pull-up Current to Pull-down Current	VI_{Ratio}	0.71		1.4	—	[7]

Table 7 Electrical Characteristics and DC Operating Conditions (cont'd)

Parameter	Symbol	Values			Unit	Note/Test Condition [1]
		Min.	Typ.	Max.		
Input Leakage Current	I_I	–2		2	µA	Any input 0 V ≤ V_{IN} ≤ V_{DD}; All other pins not under test = 0 V [8)9)]
Output Leakage Current	I_{OZ}	–5		5	µA	DQs are disabled; 0 V ≤ V_{OUT} ≤ V_{DDQ}
Output High Current, Normal Strength Driver	I_{OH}	—		–16.2	mA	V_{OUT} = 1.95 V
Output Low Current, Normal Strength Driver	I_{OL}	16.2		—	mA	V_{OUT} = 0.35 V

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

3.2 Current Specification and Conditions

Table 8 I_{DD} Conditions

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

Table 9 I_{DD} Specification for HYS64D128021[H/G]BDL–[5/6]–B

Part Number & Organization	HYS64D128021GBDL-5-B HYS64D128021HBDL-5-B		HYS64D128021GBDL-6-B HYS64D128021HBDL-6-B		Unit	Note 1)2)
	1 GB		1 GB			
	×64		×64			
	2 Ranks		2 Ranks			
	–5		–6			
Symbol	**typ.**	**max.**	**typ.**	**max.**		
I_{DD0}	1136	1360	1016	1232	mA	3)
I_{DD1}	1256	1520	1136	1352	mA	3)4)
I_{DD2P}	48	80	48	64	mA	5)
I_{DD2F}	480	576	400	480	mA	5)
I_{DD2Q}	304	416	272	384	mA	5)
I_{DD3P}	192	256	176	240	mA	5)
I_{DD3N}	672	800	592	704	mA	5)
I_{DD4R}	1296	1560	1136	1352	mA	3)4)
I_{DD4W}	1336	1600	1176	1392	mA	3)
I_{DD5}	2296	2760	2056	2472	mA	3)
I_{DD6}	tbd	tbd	tbd	tbd	mA	5)
I_{DD7}	3096	3680	2776	3272	mA	3)4)

1) Module I_{DD} values are calculated on the basis of component I_{DD} and can be measured differently according to DQ loading capacity.

2) Test condition for maximum values: V_{DD} = 2.7 V, T_A = 10 °C

3) The module I_{DDx} values are calculated from the I_{DDx} values of the component data sheet as follows: **m** × I_{DDx}[component] + **n** × I_{DD3N}[component] with **m** and **n** number of components of rank 1 and 2; **n**=0 for 1 rank modules

4) DQ I/O (I_{DDQ}) currents are not included in the calculations

5) The module I_{DDx} values are calculated from the corrponent I_{DDx} data sheet values as: (**m** + **n**) × I_{DDx}[component]

3.3 AC Characteristics

Table 10 AC Timing - Absolute Specifications –6/–5

Parameter	Symbol	–6		–5		Unit	Note/ Test Condition [1]
		DDR333B		DDR400B			
		Min.	Max.	Min.	Max.		
DQ output access time from CK/$\overline{CK}$	t_{AC}	–0.7	+0.7	–0.6	+0.6	ns	2)3)4)5)
DQS output access time from CK/$\overline{CK}$	t_{DQSCK}	–0.6	+0.6	–0.5	+0.5	ns	2)3)4)5)
CK high-level width	t_{CH}	0.45	0.55	0.45	0.55	t_{CK}	2)3)4)5)
CK low-level width	t_{CL}	0.45	0.55	0.45	0.55	t_{CK}	2)3)4)5)
Clock Half Period	t_{HP}	min. (t_{CL}, t_{CH})		min. (t_{CL}, t_{CH})		ns	2)3)4)5)
Clock cycle time	t_{CK}	—	—	5	12	ns	CL = 3.0 2)3)4)5)
		6	12	6	12	ns	CL = 2.5 2)3)4)5)
		7.5	12	7.5	12	ns	CL = 2.0 2)3)4)5)
DQ and DM input hold time	t_{DH}	0.45	—	0.4	—	ns	2)3)4)5)
DQ and DM input setup time	t_{DS}	0.45	—	0.4	—	ns	2)3)4)5)
Control and Addr. input pulse width (each input)	t_{IPW}	2.2	—	2.2	—	ns	2)3)4)5)6)
DQ and DM input pulse width (each input)	t_{DIPW}	1.75	—	1.75	—	ns	2)3)4)5)6)
Data-out high-impedance time from CK/$\overline{CK}$	t_{HZ}	—	+0.7	—	+0.6	ns	2)3)4)5)7)
Data-out low-impedance time from CK/$\overline{CK}$	t_{LZ}	–0.7	+0.7	–0.6	+0.6	ns	2)3)4)5)7)
Write command to 1st DQS latching transition	t_{DQSS}	0.75	1.25	0.75	1.25	t_{CK}	2)3)4)5)
DQS-DQ skew (DQS and associated DQ signals)	t_{DQSQ}	—	+0.40	—	+0.40	ns	TFBGA 2)3)4)5)
Data hold skew factor	t_{QHS}	—	+0.50	—	+0.50	ns	TFBGA 2)3)4)5)
DQ/DQS output hold time	t_{QH}	t_{HP} – t_{QHS}	—	t_{HP} – t_{QHS}	—	ns	2)3)4)5)
DQS input low (high) pulse width (write cycle)	$t_{DQSL,H}$	0.35	—	0.35	—	t_{CK}	2)3)4)5)
DQS falling edge to CK setup time (write cycle)	t_{DSS}	0.2	—	0.2	—	t_{CK}	2)3)4)5)
DQS falling edge hold time from CK (write cycle)	t_{DSH}	0.2	—	0.2	—	t_{CK}	2)3)4)5)
Mode register set command cycle time	t_{MRD}	2	—	2	—	t_{CK}	2)3)4)5)
Write preamble setup time	t_{WPRES}	0	—	0	—	ns	2)3)4)5)8)
Write postamble	t_{WPST}	0.40	0.60	0.40	0.60	t_{CK}	2)3)4)5)9)
Write preamble	t_{WPRE}	0.25	—	0.25	—	t_{CK}	2)3)4)5)

Table 10 AC Timing - Absolute Specifications –6/–5 (cont'd)

Parameter	Symbol	–6		–5		Unit	Note/ Test Condition [1]
		DDR333B		DDR400B			
		Min.	Max.	Min.	Max.		
Address and control input setup time	t_{IS}	0.75	—	0.6	—	ns	fast slew rate 3)4)5)6)10)
		0.8	—	0.7	—	ns	slow slew rate 3)4)5)6)10)
Address and control input hold time	t_{IH}	0.75	—	0.6	—	ns	fast slew rate 3)4)5)6)10)
		0.8	—	0.7	—	ns	slow slew rate 3)4)5)6)10)
Read preamble	t_{RPRE}	0.9	1.1	0.9	1.1	t_{CK}	2)3)4)5)
Read postamble	t_{RPST}	0.40	0.60	0.40	0.60	t_{CK}	2)3)4)5)
Active to Precharge command	t_{RAS}	42	70E+3	40	70E+3	ns	2)3)4)5)
Active to Active/Auto-refresh command period	t_{RC}	60	—	55	—	ns	2)3)4)5)
Auto-refresh to Active/Auto-refresh command period	t_{RFC}	72	—	65	—	ns	2)3)4)5)
Active to Read or Write delay	t_{RCD}	18	—	15	—	ns	2)3)4)5)
Precharge command period	t_{RP}	18	—	15	—	ns	2)3)4)5)
Active to Autoprecharge delay	t_{RAP}	18	—	15	—	ns	2)3)4)5)
Active bank A to Active bank B command	t_{RRD}	12	—	10	—	ns	2)3)4)5)
Write recovery time	t_{WR}	15	—	15	—	ns	2)3)4)5)
Auto precharge write recovery + precharge time	t_{DAL}					t_{CK}	2)3)4)5)11)
Internal write to read command delay	t_{WTR}	1	—	1	—	t_{CK}	2)3)4)5)
Exit self-refresh to non-read command	t_{XSNR}	75	—	75	—	ns	2)3)4)5)
Exit self-refresh to read command	t_{XSRD}	200	—	200	—	t_{CK}	2)3)4)5)
Average Periodic Refresh Interval	t_{REFI}	—	7.8	—	7.8	µs	2)3)4)5)12)

1) 0 °C ≤ T_A ≤ 70 °C; V_{DDQ} = 2.5 V ± 0.2 V, V_{DD} = +2.5 V ± 0.2 V (DDR333); V_{DDQ} = 2.6 V ± 0.1 V, V_{DD} = +2.6 V ± 0.1 V (DDR400)

2) Input slew rate ≥ 1 V/ns for DDR400, DDR333

3) The CK/$\overline{CK}$ input reference level (for timing reference to CK/$\overline{CK}$) is the point at which CK and $\overline{CK}$ cross: the input reference level for signals other than CK/$\overline{CK}$, is V_{REF}. CK/$\overline{CK}$ slew rate are ≥ 1.0 V/ns.

4) Inputs are not recognized as valid until V_{REF} stabilizes.

5) The Output timing reference level, as measured at the timing reference point indicated in AC Characteristics (note 3) is V_{TT}.

6) These parameters guarantee device timing, but they are not necessarily tested on each device.

7) t_{HZ} and t_{LZ} transitions occur in the same access time windows as valid data transitions. These parameters are not referred to a specific voltage level, but specify when the device is no longer driving (HZ), or begins driving (LZ).

8) The specific requirement is that DQS be valid (HIGH, LOW, or some point on a valid transition) on or before this CK edge. A valid transition is defined as monotonic and meeting the input slew rate specifications of the device. When no writes were previously in progress on the bus, DQS will be transitioning from Hi-Z to logic LOW. If a previous write was in progress, DQS could be HIGH, LOW, or transitioning from HIGH to LOW at this time, depending on t_{DQSS}.

9) The maximum limit for this parameter is not a device limit. The device operates with a greater value for this parameter, but system performance (bus turnaround) degrades accordingly.

10) Fast slew rate ≥ 1.0 V/ns , slow slew rate ≥ 0.5 V/ns and < 1 V/ns for command/address and CK & $\overline{CK}$ slew rate > 1.0 V/ns, measured between $V_{OH(ac)}$ and $V_{OL(ac)}$.

11) For each of the terms, if not already an integer, round to the next highest integer. t_{CK} is equal to the actual system clock cycle time.

12) A maximum of eight Autorefresh commands can be posted to any given DDR SDRAM device.

4 SPD Contents

Table 11 SPD Codes for HYS64D128021[H/G]BDL–[5/6]–B

	Product Type & Organization	HYS64D128021HBDL–5–B	HYS64D128021GBDL–5–B	HYS64D128021HBDL–6–B	HYS64D128021GBDL–6–B
		1 GByte	1 GByte	1 GByte	1 GByte
		×64	×64	×64	×64
		2 Ranks	2 Ranks	2 Ranks	2 Ranks
	Label Code	**PC3200S–3033–1**	**PC3200S–3033–1**	**PC2700S–2533–0**	**PC2700S–2533–0**
	Jedec SPD Revision	**Rev 1.0**	**Rev 1.0**	**Rev 0.0**	**Rev 0.0**
Byte#	**Description**	**HEX**	**HEX**	**HEX**	**HEX**
0	Programmed SPD Bytes in E2PROM	80	80	80	80
1	Total number of Bytes in E2PROM	08	08	08	08
2	Memory Type (DDR = 07h)	07	07	07	07
3	Number of Row Addresses	0D	0D	0D	0D
4	Number of Column Addresses	0B	0B	0B	0B
5	Number of DIMM Ranks	02	02	02	02
6	Data Width (LSB)	40	40	40	40
7	Data Width (MSB)	00	00	00	00
8	Interface Voltage Levels	04	04	04	04
9	tCK @ CLmax (Byte 18) [ns]	50	50	60	60
10	tAC SDRAM @ CLmax (Byte 18) [ns]	50	50	70	70
11	Error Correction Support	00	00	00	00
12	Refresh Rate	82	82	82	82
13	Primary SDRAM Width	08	08	08	08
14	Error Checking SDRAM Width	00	00	00	00
15	tCCD [cycles]	01	01	01	01
16	Burst Length Supported	0E	0E	0E	0E
17	Number of Banks on SDRAM Device	04	04	04	04
18	CAS Latency	1C	1C	0C	0C
19	CS Latency	01	01	01	01
20	Write Latency	02	02	02	02
21	DIMM Attributes	20	20	20	20

Table 11 SPD Codes for HYS64D128021[H/G]BDL–[5/6]–B

	Product Type & Organization	HYS64D128021HBDL–5–B	HYS64D128021GBDL–5–B	HYS64D128021HBDL–6–B	HYS64D128021GBDL–6–B
		1 GByte	1 GByte	1 GByte	1 GByte
		×64	×64	×64	×64
		2 Ranks	2 Ranks	2 Ranks	2 Ranks
	Label Code	**PC3200S–3033–1**	**PC3200S–3033–1**	**PC2700S–2533–0**	**PC2700S–2533–0**
	Jedec SPD Revision	**Rev 1.0**	**Rev 1.0**	**Rev 0.0**	**Rev 0.0**
Byte#	**Description**	**HEX**	**HEX**	**HEX**	**HEX**
22	Component Attributes	C1	C1	C1	C1
23	tCK @ CLmax -0.5 (Byte 18) [ns]	60	60	75	75
24	tAC SDRAM @ CLmax -0.5 [ns]	50	50	70	70
25	tCK @ CLmax -1 (Byte 18) [ns]	75	75	00	00
26	tAC SDRAM @ CLmax -1 [ns]	50	50	00	00
27	tRPmin [ns]	3C	3C	48	48
28	tRRDmin [ns]	28	28	30	30
29	tRCDmin [ns]	3C	3C	48	48
30	tRASmin [ns]	28	28	2A	2A
31	Module Density per Rank	80	80	80	80
32	tAS, tCS [ns]	60	60	75	75
33	tAH, TCH [ns]	60	60	75	75
34	tDS [ns]	40	40	45	45
35	tDH [ns]	40	40	45	45
36 – 40	not used	00	00	00	00
41	tRCmin [ns]	37	37	3C	3C
42	tRFCmin [ns]	41	41	48	48
43	tCKmax [ns]	28	28	30	30
44	tDQSQmax [ns]	28	28	28	28
45	tQHSmax [ns]	50	50	50	50
46	not used	00	00	00	00
47	DIMM PCB Height	01	01	00	00
48 – 61	not used	00	00	00	00
62	SPD Revision	10	10	00	00
63	Checksum of Byte 0-62	50	50	39	39
64	JEDEC ID Code of Infineon (1)	C1	C1	C1	C1
65 – 71	JEDEC ID Code of Infineon (2 – 8)	00	00	00	00

Table 11 SPD Codes for HYS64D128021[H/G]BDL–[5/6]–B

	Product Type & Organization	HYS64D128021HBDL–5–B	HYS64D128021GBDL–5–B	HYS64D128021HBDL–6–B	HYS64D128021GBDL–6–B
		1 GByte	1 GByte	1 GByte	1 GByte
		×64	×64	×64	×64
		2 Ranks	2 Ranks	2 Ranks	2 Ranks
	Label Code	**PC3200S–3033–1**	**PC3200S–3033–1**	**PC2700S–2533–0**	**PC2700S–2533–0**
	Jedec SPD Revision	**Rev 1.0**	**Rev 1.0**	**Rev 0.0**	**Rev 0.0**
Byte#	**Description**	**HEX**	**HEX**	**HEX**	**HEX**
72	Module Manufacturer Location	xx	xx	xx	xx
73	Part Number, Char 1	36	36	36	36
74	Part Number, Char 2	34	34	34	34
75	Part Number, Char 3	44	44	44	44
76	Part Number, Char 4	31	31	31	31
77	Part Number, Char 5	32	32	32	32
78	Part Number, Char 6	38	38	38	38
79	Part Number, Char 7	30	30	30	30
80	Part Number, Char 8	32	32	32	32
81	Part Number, Char 9	31	31	31	31
82	Part Number, Char 10	48	47	48	47
83	Part Number, Char 11	42	42	42	42
84	Part Number, Char 12	44	44	44	44
85	Part Number, Char 13	4C	4C	4C	4C
86	Part Number, Char 14	35	35	36	36
87	Part Number, Char 15	42	42	42	42
88	Part Number, Char 16	20	20	20	20
89	Part Number, Char 17	20	20	20	20
90	Part Number, Char 18	20	20	20	20
91	Module Revision Code	xx	xx	xx	xx
92	Test Program Revision Code	xx	xx	xx	xx
93	Module Manufacturing Date Year	xx	xx	xx	xx
94	Module Manufacturing Date Week	xx	xx	xx	xx
95 – 98	Module Serial Number (1 – 4)	xx	xx	xx	xx
99 – 127	not used	00	00	00	00

5 Package Outlines

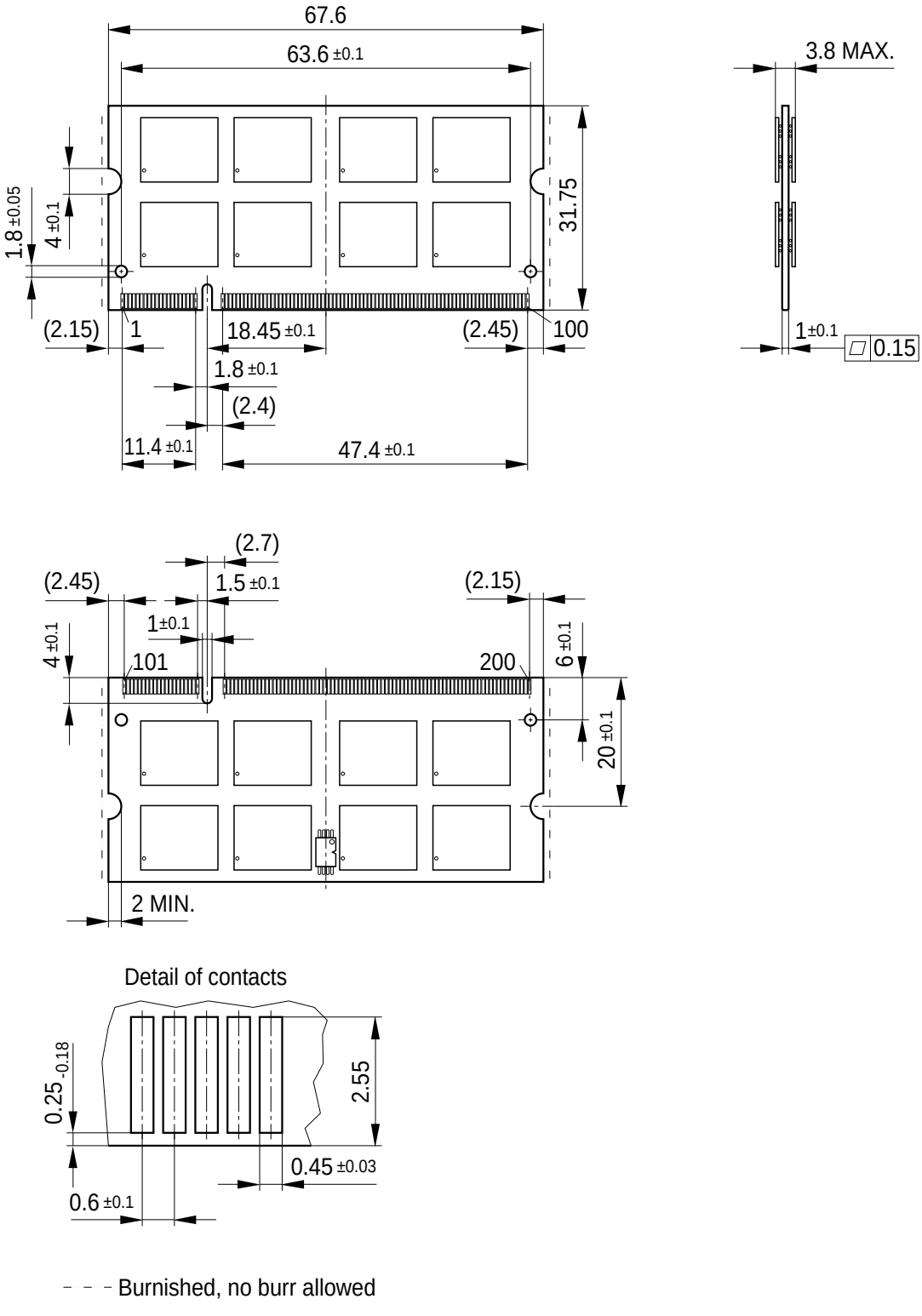


Figure 3 Package Outlines – DDR-SDRAM SO-DIMM HYS64D128021[H/G]BDL–[5/6]–B

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