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4Gb DDR3 SDRAM
MKRD3B51208HB10AA
MKRD3B25616HG13AB
Specification

ORDERING INFORMATION

Part No.	Configuration	Frequency [MHz]	Package
MKRD3B51208HB10AA	512M x 8	1333	78ball FBGA
MKRD3B25616HG13AB	256M x 16	1866	96ball FBGA

Pin Configurations

Pin Configurations (×4/×8 configuration)

/xxx indicates active low signal.

78-ball FBGA (×4 configuration)

	1	2	3	7	8	9
A	VSS	VDD	NC	NC	VSS	VDD
B	VSS	VSSQ	DQ0	DM	VSSQ	VDDQ
C	VDDQ	DQ2	DQS	DQ1	DQ3	VSSQ
D	VSSQ	NC	/DQS	VDD	VSS	VSSQ
E	VREFDQ	VDDQ	NC	NC	NC	VDDQ
F	NC	VSS	/RAS	CK	VSS	NC
G	ODT	VDD	/CAS	/CK	VDD	CKE
H	NC	/CS	/WE	A10(AP)	ZQ	NC
J	VSS	BA0	BA2	A15	VREFCA	VSS
K	VDD	A3	A0	A12(/BC)	BA1	VDD
L	VSS	A5	A2	A1	A4	VSS
M	VDD	A7	A9	A11	A6	VDD
N	VSS	/RESET	A13	A14	A8	VSS

(Top view)

78-ball FBGA (×8 configuration)

	1	2	3	7	8	9
A	VSS	VDD	NC	NU/(/TDQS)	VSS	VDD
B	VSS	VSSQ	DQ0	DM/TDQS	VSSQ	VDDQ
C	VDDQ	DQ2	DQS	DQ1	DQ3	VSSQ
D	VSSQ	DQ6	/DQS	VDD	VSS	VSSQ
E	VREFDQ	VDDQ	DQ4	DQ7	DQ5	VDDQ
F	NC	VSS	/RAS	CK	VSS	NC
G	ODT	VDD	/CAS	/CK	VDD	CKE
H	NC	/CS	/WE	A10(AP)	ZQ	NC
J	VSS	BA0	BA2	A15	VREFCA	VSS
K	VDD	A3	A0	A12(/BC)	BA1	VDD
L	VSS	A5	A2	A1	A4	VSS
M	VDD	A7	A9	A11	A6	VDD
N	VSS	/RESET	A13	A14	A8	VSS

(Top view)

Pin name	Function	Pin name	Function
A0 to A15* [3]	Address inputs A10(AP): Auto precharge A12(/BC): Burst chop	RESET* [3]	Active low asynchronous reset
BA0 to BA2* [3]	Bank select	VDD	Supply voltage for internal circuit
DQ0 to DQ7	Data input/output	VSS	Ground for internal circuit
DQS, /DQS	Differential data strobe	VDDQ	Supply voltage for DQ circuit
TDQS, /TDQS	Termination data strobe	VSSQ	Ground for DQ circuit
/CS* [3]	Chip select	VREFDQ	Reference voltage for DQ
/RAS, /CAS, /WE* [3]	Command input	VREFCA	Reference voltage for CA
CKE* [3]	Clock enable	ZQ	Reference pin for ZQ calibration
CK, /CK	Differential clock input	NC* [1]	No connection
DM	Write data mask	NU* [2]	Not usable
ODT* [3]	ODT control		

Notes: 1. Not internally connected with die.
2. Don't connect. Internally connected.
3. Input only pins (address, command, CKE, ODT and /RESET) do not supply termination.

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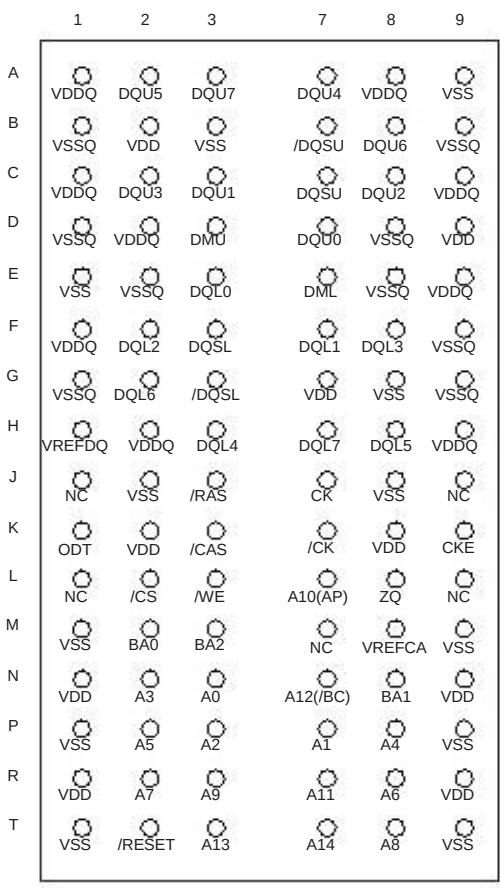
Pin Configurations (× 16 configuration)

/xxx indicates active low signal.

96-ball FBGA



(Top view)

Pin name	Function	Pin name	Function
A0 to A14* [2]	Address inputs A10(AP): Auto precharge A12(/BC): Burst chop	/RESET* [2]	Active low asynchronous reset
BA0 to BA2* [2]	Bank select	VDD	Supply voltage for internal circuit
DQU0 to DQU7 DQL0 to DQL7	Data input/output	VSS	Ground for internal circuit
DQSU, /DQSU DQSL, /DQSL	Differential data strobe	VDDQ	Supply voltage for DQ circuit
/CS* [2]	Chip select	VSSQ	Ground for DQ circuit
/RAS, /CAS, /WE* [2]	Command input	VREFDQ	Reference voltage for DQ
CKE* [2]	Clock enable	VREFCA	Reference voltage for CA
CK, /CK	Differential clock input	ZQ	Reference pin for ZQ calibration
DMU, DML	Write data mask	NC* [1]	No connection
ODT* [2]	ODT control		

Notes: 1. Not internally connected with die.

2. Input only pins (address, command, CKE, ODT and /RESET) do not supply termination.

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1. Electrical Conditions

• All voltages are referenced to VSS (GND)

• Execute power-up and Initialization sequence before proper device operation is achieved.

1.1 Absolute Maximum Ratings

Table 1: Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit	Notes
Power supply voltage	VDD	- 0.4 to +1.975	V	1, 3
Power supply voltage for output	VDDQ	- 0.4 to +1.975	V	1, 3
Input voltage	VIN	- 0.4 to +1.975	V	1
Output voltage	VOUT	- 0.4 to +1.975	V	1
Reference voltage	VREFCA	- 0.4 to x 0.6 x VDD	V	3
Reference voltage for DQ	VREFDQ	- 0.4 to x 0.6 x VDDQ	V	3
Storage temperature	Tstg	-55 to +100	°C	1, 2
Power dissipation	PD	1.0	W	1
Short circuit output current	IOUT	50	mA	1

Notes: 1. Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

2. Storage temperature is the case surface temperature on the center/top side of the DRAM.

3. VDD and VDDQ must be within 300mV of each other at all times; and VREF must be no greater than 0.6 x VDDQ, When VDD and VDDQ are less than 500mV; VREF may be equal to or less than 300mV.

Caution: Exposing the device to stress above those listed in Absolute Maximum Ratings could cause permanent damage. The device is not meant to be operated under conditions outside the limits described in the operational section of this specification. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

1.2 Operating Temperature Condition

Table 2: Operating Temperature Condition

Parameter	Symbol	Rating	Unit	Notes
Operating case temperature	TC	0 to +95	°C	1, 2, 3

Notes: 1. Operating temperature is the case surface temperature on the center/top side of the DRAM.

2. The Normal Temperature Range specifies the temperatures where all DRAM specifications will be supported. During operation, the DRAM case temperature must be maintained between 0°C to +85°C under all operating conditions.

3. Some applications require operation of the DRAM in the Extended Temperature Range between +85°C and +95°C case temperature. Full specifications are guaranteed in this range, but the following additional conditions apply:

a) Refresh commands must be doubled in frequency, therefore reducing the refresh interval tREFI to 3.9µs. (This double refresh requirement may not apply for some devices.)

b) If Self-refresh operation is required in the Extended Temperature Range, then it is mandatory to either use the Manual Self-Refresh mode with Extended Temperature Range capability (MR2 bit [A6, A7] = [0, 1]) or enable the optional Auto Self-Refresh mode (MR2 bit [A6, A7] = [1, 0]).

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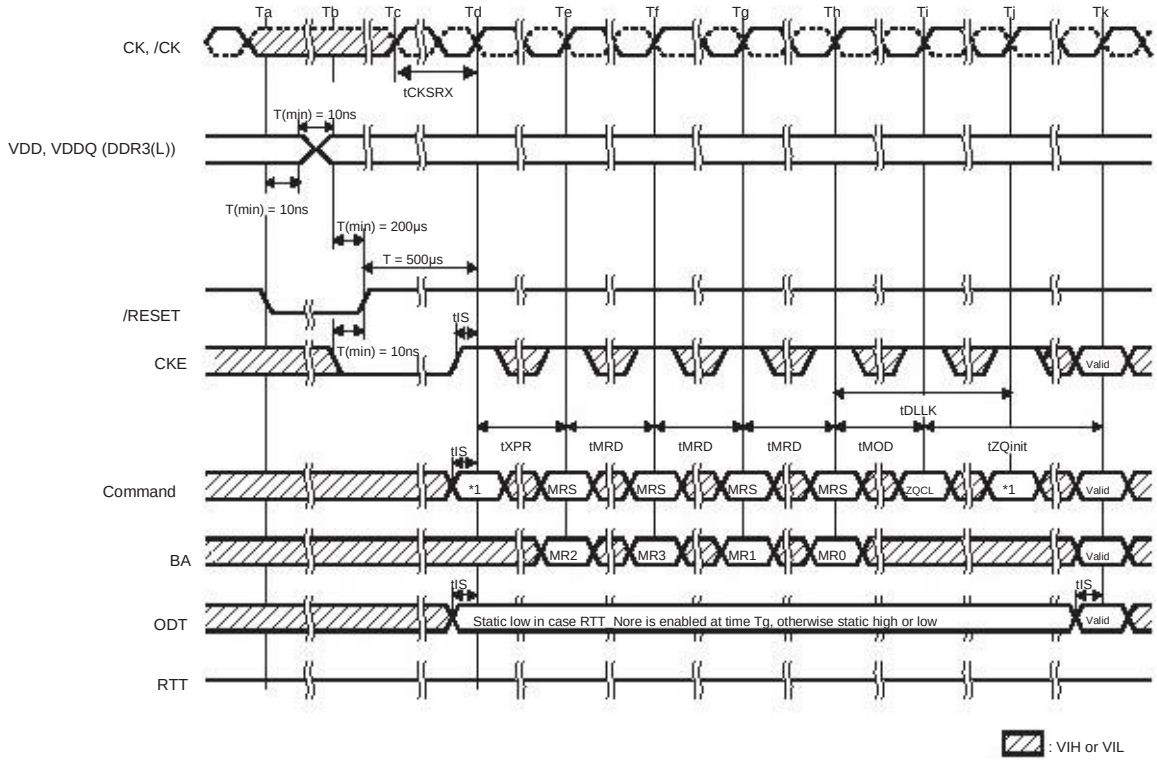
1.3 Recommended DC Operating Conditions

Table 3: Recommended DC Operating Conditions (TC = 0°C to +85°C), DDR3(L) Operation

Parameter	Symbol	min.	typ.	max.	Unit
Supply voltage DDR3	VDD/VDDQ	1.425	1.5	1.575	V
Supply voltage DDR3L	VDD/VDDQ	1.283	1.35	1.45	V

Notes :

Once initialized for DDR3(L),DDR3(L) operation may only be used if the device is in reset while VDD and VDDQ are changed for DDR3(L) operation shown as following timing wave form.



Note: 1. From time point Td until Tk, NOP or DES commands must be applied between MRS and ZQCL commands.

Figure 1: VDD/VDDQ Voltage Switch

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1.4 IDD and IDDQ Measurement Conditions

In this chapter, IDD and IDDQ measurement conditions such as test load and patterns are defined.

The figure Measurement Setup and Test Load for IDD and IDDQ Measurements shows the setup and test load for IDD and IDDQ measurements.

- IDD currents (such as IDD0, IDD1, IDD2N, IDD2NT, IDD2P0, IDD2P1, IDD2Q, IDD3N, IDD3P, IDD4R, IDD4W, IDD5B, IDD6, IDD6ET, IDD6TC and IDD7) are measured as time-averaged currents with all VDD balls of the DDR3(L) SDRAM under test tied together. Any IDDQ current is not included in IDD currents.
- IDDQ currents (such as IDDQ2NT and IDDQ4R) are measured as time-averaged currents with all VDDQ balls of the DDR3(L) SDRAM under test tied together. Any IDD current is not included in IDDQ currents.

  Note:IDDQ values cannot be directly used to calculate I/O power of the DDR3(L) SDRAM. They can be used to support correlation of simulated I/O power to actual I/O power as outlined in correlation from simulated channel I/O power to actual channel I/O power supported by IDDQ measurement.

For IDD and IDDQ measurements, the following definitions apply:

- L and 0: VIN ≤ VIL(AC)max
- H and 1: VIN ≥ VIH(AC)min
- MID-LEVEL: defined as inputs are VREF = VDDQ / 2
- FLOATING: don't care or floating around VREF.
- Timings used for IDD and IDDQ measurement-loop patterns are provided in Timings used for IDD and IDDQ Measurement-Loop Patterns table.
- Basic IDD and IDDQ measurement conditions are described in Basic IDD and IDDQ Measurement Conditions table.

  Note:The IDD and IDDQ measurement-loop patterns need to be executed at least one time before actual IDD or IDDQ measurement is started.
- Detailed IDD and IDDQ measurement-loop patterns are described in IDD0 Measurement-Loop Pattern table through IDD7 Measurement-Loop Pattern table.
- IDD Measurements are done after properly initializing the DDR3(L) SDRAM. This includes but is not limited to

  setting. RON = RZQ/7 (34Ω in MR1);

  Qoff = 0B (Output Buffer enabled in MR1);

  RTT_Nom = RZQ/6 (40Ω in MR1);

  RTT_WR = RZQ/2 (120Ω in MR2);

  TDQS Feature disabled in MR1
- Define D = {/CS, /RAS, /CAS, /WE} : = {H, L, L, L}
- Define /D = {/CS, /RAS, /CAS, /WE} : = {H, H, H, H}

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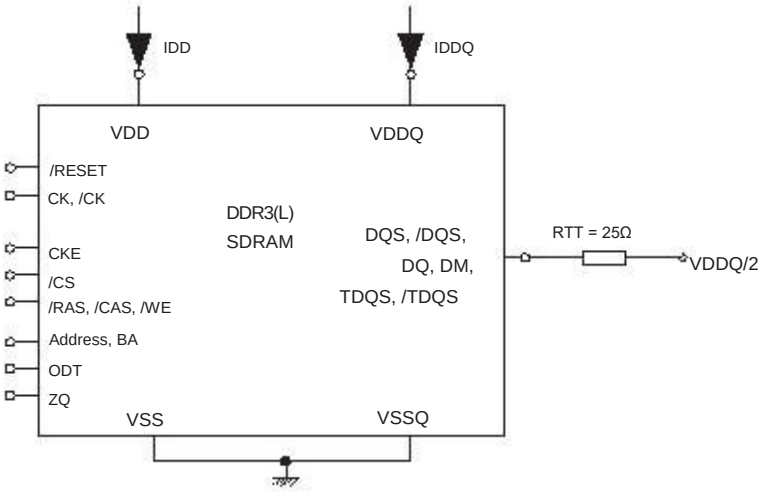

Figure 2: Measurement Setup and Test Load for IDD and IDDQ Measurements

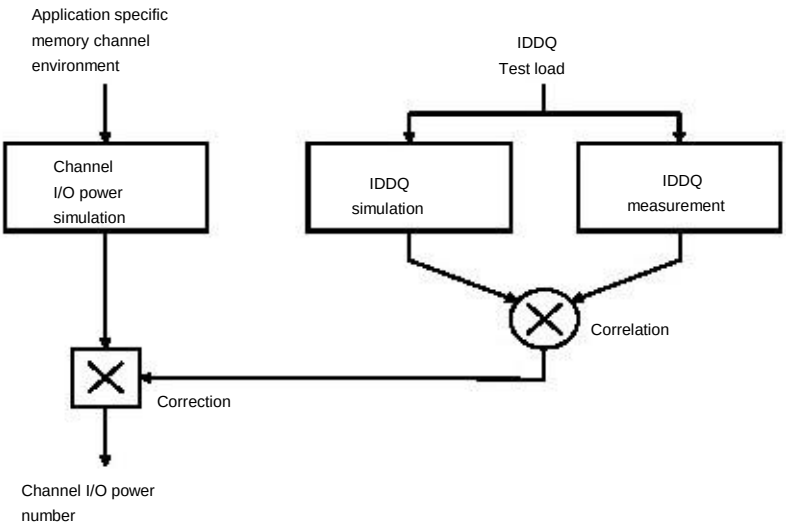

Figure 3: Correlation from Simulated Channel I/O Power to Actual Channel I/O Power Supported by IDDQ Measurement

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1.4.1 Timings Used for IDD and IDDQ Measurement-Loop Patterns

Table 4: Timings Used for IDD and IDDQ Measurement-Loop Patterns

	DDR3(L)-1866	DDR3(L)-1600	DDR3(L)-1333	
Parameter	13-13-13	11-11-11	9-9-9	Unit
CL	13	11	9	nCK
tCK(min)	1.07	1.25	1.5	ns
nRCD(min)	13	11	9	nCK
nRC(min)	45	39	33	nCK
nRAS(min)	32	28	24	nCK
nRP(min)	13	11	9	nCK
nFAW (1KB)	26	24	20	nCK
nFAW (2KB, 4KB)	33	32	30	nCK
nRRD (1KB)	5	5	4	nCK
nRRD (2KB, 4KB)	6	6	5	nCK
nRFC (1Gb)	103	88	74	nCK
nRFC (2Gb)	150	128	107	nCK
nRFC (4Gb)	243	208	174	nCK

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1.4.2 Basic IDD and IDDQ Measurement Conditions

Table 5: Basic IDD and IDDQ Measurement Conditions

Parameter	Symbol	Description
Operating one bank active precharge current	IDD0	CKE: H; External clock: on; tCK, nRC, nRAS, CL: see Table 5; BL: 8*[1]; AL: 0; /CS: H between ACT and PRE; Command, address, bank address inputs: partially toggling according to Table 7; Data I/O: MID-LEVEL; DM: stable at 0; Bank activity: cycling with one bank active at a time: 0,0,1,1,2,2,... (see Table 7); Output buffer and RTT: enabled in MR*[2]; ODT signal: stable at 0; Pattern details: see Table 7
Operating one bank active-read-precharge current	IDD1	CKE: H; External clock: On; tCK, nRC, nRAS, nRCD, CL: see Table 5; BL: 8*[1,6]; AL: 0; /CS: H between ACT, RD and PRE; Command, address, bank address inputs, data I/O: partially toggling according to Table 8; DM: stable at 0; Bank activity: cycling with one bank active at a time: 0,0,1,1,2,2,... (see Table 8); Output buffer and RTT: enabled in MR*[2]; ODT Signal: stable at 0; Pattern details: see Table 8
Precharge standby current	IDD2N	CKE: H; External clock: on; tCK, CL: see Table 5 BL: 8*[1]; AL: 0; /CS: stable at 1; Command, address, bank address Inputs: partially toggling according to Table 9; data I/O: MID-LEVEL; DM: stable at 0; bank activity: all banks closed; output buffer and RTT: enabled in mode registers*[2]; ODT signal: stable at 0; pattern details: see Table 9
Precharge standby ODT current	IDD2NT	CKE: H; External clock: on; tCK, CL: see Table 5; BL: 8*[1]; AL: 0; /CS: stable at 1; Command, address, bank address Inputs: partially toggling according to Table 10; data I/O: MID-LEVEL; DM: stable at 0; bank activity: all banks closed; output buffer and RTT: enabled in MR*[2]; ODT signal: toggling according to Table 10; pattern details: see Table 10
Precharge standby ODT IDDQ current	IDDQ2NT	Same definition like for IDD2NT, however measuring IDDQ current instead of IDD current
Precharge power-down current slow exit	IDD2P0	CKE: L; External clock: on; tCK, CL: see Table 5; BL: 8*[1]; AL: 0; /CS: stable at 1; Command, address, bank address inputs: stable at 0; data I/O: MID-LEVEL; DM: stable at 0; bank activity: all banks closed; output buffer and RTT: EMR*[2]; ODT signal: stable at 0; precharge power down mode: slow exit*[3]
Precharge power-down current fast exit	IDD2P1	CKE: L; External clock: on; tCK, CL: see Table 6; BL: 8*[1]; AL: 0; /CS: stable at 1; Command, address, bank address Inputs: stable at 0; data I/O: MID-LEVEL; DM:stable at 0; bank activity: all banks closed; output buffer and RTT: enabled in MR*[2]; ODT signal: stable at 0; precharge power down mode: fast exit*[3]
Precharge quiet standby current	IDD2Q	CKE: H; External clock: On; tCK, CL: see Table 5; BL: 8*[1]; AL: 0; /CS: stable at 1; Command, address, bank address Inputs: stable at 0; data I/O: MID-LEVEL; DM: stable at 0;bank activity: all banks closed; output buffer and RTT: enabled in MR*2; ODT signal: stable at 0
Active standby current	IDD3N	CKE: H; External clock: on; tCK, CL: see Table 5; BL: 8*[1]; AL: 0; /CS: stable at 1; Command, address, bank address Inputs: partially toggling according to Table 9; data I/O: MID-LEVEL; DM: stable at 0; bank activity: all banks open; output buffer and RTT: enabled in MR*[2]; ODT signal: stable at 0; pattern details: see Table 9
Active power-down current	IDD3P	CKE: L; External clock: on; tCK, CL: see Table 5; BL: 8*[1]; AL: 0; /CS: stable at 1; Command, address, bank address inputs: stable at 0; data I/O: MID-LEVEL; DM:stable at 0; bank activity: all banks open; output buffer and RTT: enabled in MR*[2]; ODT signal: stable at 0
Operating burst read current	IDD4R	CKE: H; External clock: on; tCK, CL: see Table 5; BL: 8*[1,6]; AL: 0; /CS: H between RD; Command, address, bank address Inputs: partially toggling according to Table 11; data I/O: seamless read data burst with different data between one burst and the next one according to Table 11; DM: stable at 0; bank activity: all banks open, RD commands cycling through banks: 0,0,1,1,2,2,... (see Table 11); Output buffer and RTT: enabled in MR*[2]; ODT signal: stable at 0; pattern details: see Table 11
Operating burst read IDDQ current	IDDQ4R	Same definition like for IDD4R, however measuring IDDQ current instead of IDD current

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Table 6: Basic IDD and IDDQ Measurement Conditions (cont'd)

Parameter	Symbol	Description
Operating burst write current	IDD4W	CKE: H; External clock: on; tCK, CL: see Table 5; BL: 8*[1]; AL: 0; /CS: H between WR; command, address, bank address inputs: partially toggling according to Table 12; data I/O: seamless write data burst with different data between one burst and the next one according to IDD4W Measurement-Loop Pattern table; DM: stable at 0; bank activity: all banks open, WR commands cycling through banks: 0,0,1,1,2,2,.. (see Table 12); Output buffer and RTT: enabled in MR*[2]; ODT signal: stable at H; pattern details: see Table 12
Burst refresh current	IDD5B	CKE: H; External clock: on; tCK, CL, nRFC: see Table 5; BL: 8*[1]; AL: 0; /CS: H between REF; Command, address, bank address Inputs: partially toggling according to Table 13; data I/O: MID-LEVEL; DM: stable at 0; bank activity: REF command every nRFC (Table 13); output buffer and RTT: enabled in MR*[2]; ODT signal: stable at 0; pattern details: see Table 13
Self-refresh current: normal temperature range	IDD6	TC: 0 to 85°C; ASR: disabled*[4]; SRT: Normal*[5]; CKE: L; External clock: off; CK and /CK: L; CL: see Table 5; BL: 8*[1]; AL: 0; /CS, command, address, bank address, data I/O: MID-LEVEL; DM: stable at 0; bank activity: Self-refresh operation; output buffer and RTT: enabled in MR*[2]; ODT signal: MID-LEVEL
Self-refresh current: extended temperature range	IDD6ET	TC: 0 to 95°C; ASR: Disabled*[4]; SRT: Extended*[5]; CKE: L; External clock: off; CK and /CK: L; CL: Table 5; BL: 8*[1]; AL: 0; /CS, command, address, bank address, data I/O: MID-LEVEL; DM: stable at 0; bank activity: Extended temperature self-refresh operation; output buffer and RTT: enabled in MR*[2]; ODT signal: MID-LEVEL
Auto self-refresh current (Optional)	IDD6TC	TC: 0 to 95°C; ASR: Enabled*[4]; SRT: Normal*[5]; CKE: L; External clock: off; CK and /CK: L; CL: Table 5; BL: 8*[1]; AL: 0; /CS, command, address, bank address, data I/O: MID-LEVEL; DM: stable at 0; bank activity: Auto self-refresh operation; output buffer and RTT: enabled in MR*[2]; ODT signal: MID-LEVEL
Operating bank interleave read current	IDD7	CKE: H; External clock: on; tCK, nRC, nRAS, nRCD, nRRD, nFAW, CL: see Table 5; BL: 8*[1], *[6]; AL: CL-1; /CS: H between ACT and RDA; Command, address, bank address Inputs: partially toggling according to Table 14; data I/O: read data bursts with different data between one burst and the next one according to Table 14; DM: stable at 0; bank activity: two times interleaved cycling through banks (0, 1, …7) with different addressing, see Table 14; output buffer and RTT: enabled in MR*2; ODT signal: stable at 0; pattern details: see Table 14
RESET low current	IDD8	/RESET: low; External clock: off; CK and /CK: low; CKE: FLOATING; /CS, command, address, bank address, Data IO: FLOATING; ODT signal: FLOATING RESET low current reading is valid once power is stable and /RESET has been low for at least 1ms.

Notes:
1. Burst Length: BL8 fixed by MRS: MR0 bits [1,0] = [0,0].
2. MR: Mode Register
   Output buffer enable: set MR1 bit A12 = 1 and MR1 bits [5, 1] = [0,1];
   RTT_Nom enable: set MR1 bits [9, 6, 2] = [0, 1, 1]; RTT_WR enable: set MR2 bits [10, 9] = [1,0].
3. Precharge power down mode: set MR0 bit A12= 0 for Slow Exit or MR0 bit A12 = 1 for fast exit.
4. Auto self-refresh (ASR): set MR2 bit A6 = 0 to disable or 1 to enable feature.
5. Self-refresh temperature range (SRT): set MR0 bit A7= 0 for normal or 1 for extended temperature range.
6. Read burst type: nibble sequential, set MR0 bit A3 = 0

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Table 7: IDD0 Measurement-Loop Pattern

CK, /CK	CKE	Sub -Loop	Cycle number	Com-Mand	/CS	/RAS	/CAS	/WE	ODT	BA* [3]	A11 -Am	A10	A7 -A9	A3 -A6	A0 -A2	Data* [2]
Toggling	Static H	0	0	ACT	0	0	1	1	0	0	0	0	0	0	0	
			1, 2	D, D	1	0	0	0	0	0	0	0	0	0	0	
			3, 4	/D, /D	1	1	1	1	0	0	0	0	0	0	0	
			…	Repeat pattern 1…4 until nRAS - 1, truncate if necessary												
			nRAS	PRE	0	0	1	0	0	0	0	0	0	0	0	
			…	Repeat pattern 1...4 until nRC - 1, truncate if necessary												
			1 X nRC +0	ACT	0	0	1	1	0	0	0	0	0	F	0	
			1 X nRC +1, 2	D, D	1	0	0	0	0	0	0	0	0	F	0	
			1 X nRC + 3, 4	/D, /D	1	1	1	1	0	0	0	0	0	F	0	
			…	Repeat pattern nRC + 1,...,4 until 1 x nRC + Nras - 1, truncate if necessary												
			1 X nRC + nRAS	PRE	0	0	1	0	0	0	0	0	0	F	0	
			…	Repeat nRC + 1,...,4 until 2 x nRC - 1, truncate if necessary												
		1	2	nRC Repeat Sub-Loop 0, use BA= 1 instead												
		2	4	nRC Repeat Sub-Loop 0, use BA= 2 instead												
		3	6	nRC Repeat Sub-Loop 0, use BA= 3 instead												
		4	8	nRC Repeat Sub-Loop 0, use BA= 4 instead												
		5	10	nRC Repeat Sub-Loop 0, use BA= 5 instead												
		6	12	nRC Repeat Sub-Loop 0, use BA= 6 instead												
		7	14	nRC Repeat Sub-Loop 0, use BA= 7 instead												

Notes: 1. DM must be driven low all the time. DQS, /DQS are MID-LEVEL.

2. DQ signals are MID-LEVEL.

3. BA: BA0 to BA2.

4. Am: m means Most Significant Bit (MSB) of Row address.

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Table 8: IDD1 Measurement-Loop Pattern

CK, /CK	CKE	Sub -Loop	Cycle number	Com-mand	/CS	/RAS	/CAS	/WE	ODT	BA* [3]	A11 -Am	A10	A7 A9	A3 -A6	A0 -A2	Data* [2]
Toggling	Static H	0	0	ACT	0	0	1	1	0	0	0	0	0	0	0	_
			1, 2	D, D	1	0	0	0	0	0	0	0	0	0	0	_
			3, 4	/D, /D	1	1	1	1	0	0	0	0	0	0	0	_
			…	Repeat pattern 1...4 until nRCD - 1, truncate if necessary												
			nRCD	RD	0	1	0	1	0	0	0	0	0	0	0	00000000
			…	Repeat pattern 1...4 until nRAS - 1, truncate if necessary												
			nRAS	PRE	0	0	1	0	0	0	0	0	0	0	0	_
			…	Repeat pattern 1...4 until nRC - 1, truncate if necessary												
			1 x nRC +0	ACT	0	0	1	1	0	0	0	0	0	F	0	_
			1 x nRC + 1, 2	D, D	1	0	0	0	0	0	0	0	0	F	0	_
			1 x nRC + 3, 4	/D, /D	1	1	1	1	0	0	0	0	0	F	0	_
			…	Repeat pattern nRC + 1,..., 4 until nRC + nRCD - 1, truncate if necessary												
			1 x nRC + nRCD	RD	0	1	0	1	0	0	0	0	0	F	0	00110011
			…	Repeat pattern nRC + 1,..., 4 until nRC +nRAS - 1, truncate if necessary												
			1 x nRC + nRAS	PRE	0	0	1	0	0	0	0	0	0	F	0	_
			…	Repeat pattern nRC + 1,..., 4 until 2 x nRC - 1, truncate if necessary												
		1	2	nRC Repeat Sub-Loop 0, use BA= 1 instead												
		2	4	nRC Repeat Sub-Loop 0, use BA= 2 instead												
		3	6	nRC Repeat Sub-Loop 0, use BA= 3 instead												
		4	8	nRC Repeat Sub-Loop 0, use BA= 4 instead												
		5	10	nRC Repeat Sub-Loop 0, use BA= 5 instead												
		6	12	nRC Repeat Sub-Loop 0, use BA= 6 instead												
		7	14	nRC Repeat Sub-Loop 0, use BA= 7 instead												

Notes: 1. DM must be driven low all the time. DQS, /DQS are used according to read commands, otherwise MID-LEVEL.

2. Burst sequence driven on each DQ signal by read command. Outside burst operation, DQ signals are MID-LEVEL.

3. BA: BA0 to BA2.

4. Am: m means Most Significant Bit (MSB) of Row address.

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Table 9: IDD2N and IDD3N Measurement-Loop Pattern

CK, /CK	CKE	Sub -Loop	Cycle number	Com-Mand	/CS	/RAS	/CAS	/WE	ODT	BA*[3]	A11 -Am	A10	A7 -A9	A3 -A6	A0 -A2	Data*[2]
Toggling	Static H	0	0	D	1	0	0	0	0	0	0	0	0	0	0	
			1	D	1	0	0	0	0	0	0	0	0	0	0	
			2	/D	1	1	1	1	0	0	0	0	0	F	0	
			3	/D	1	1	1	1	0	0	0	0	0	F	0	
		1	4 to 7	Repeat Sub-Loop 0, use BA= 1 instead												
		2	8 to 11	Repeat Sub-Loop 0, use BA= 2 instead												
		3	12 to 15	Repeat Sub-Loop 0, use BA= 3 instead												
		4	16 to 19	Repeat Sub-Loop 0, use BA= 4 instead												
		5	20 to 23	Repeat Sub-Loop 0, use BA= 5 instead												
		6	24 to 27	Repeat Sub-Loop 0, use BA= 6 instead												
		7	28 to 31	Repeat Sub-Loop 0, use BA= 7 instead												

Notes: 1. DM must be driven low all the time. DQS, /DQS are MID-LEVEL.
2. DQ signals are MID-LEVEL.
3. BA: BA0 to BA2.
4. Am: m means Most Significant Bit (MSB) of Row address.

Table 10: IDD2NT and IDDQ2NT Measurement-Loop Pattern

CK, /CK	CKE	Sub -Loop	Cycle number	Com-Mand	/CS	/RAS	/CAS	/WE	ODT	BA*3	A11 -Am	A10	A7 -A9	A3 -A6	A0 -A2	Data*[2]
Toggling	Static H	0	0	D	1	0	0	0	0	0	0	0	0	0	0	
			1	D	1	0	0	0	0	0	0	0	0	0	0	
			2	/D	1	1	1	1	0	0	0	0	0	F	0	
			3	/D	1	1	1	1	0	0	0	0	0	F	0	
		1	4 to 7	Repeat Sub-Loop 0, but ODT = 0 and BA= 1												
		2	8 to 11	Repeat Sub-Loop 0, but ODT = 1 and BA= 2												
		3	12 to 15	Repeat Sub-Loop 0, but ODT = 1 and BA= 3												
		4	16 to 19	Repeat Sub-Loop 0, but ODT = 0 and BA= 4												
		5	20 to 23	Repeat Sub-Loop 0, but ODT = 0 and BA= 5												
		6	24 to 27	Repeat Sub-Loop 0, but ODT = 1 and BA= 6												
		7	28 to 31	Repeat Sub-Loop 0, but ODT = 1 and BA= 7												

Notes: 1. DM must be driven low all the time. DQS, /DQS are MID-LEVEL.
2. DQ signals are MID-LEVEL.
3. BA: BA0 to BA2.
4. Am: m means Most Significant Bit (MSB) of Row address.

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Table 11: IDD4R and IDDQ4R Measurement-Loop Pattern

CK, /CK	CKE	Sub -Loop	Cycle number	Com-mand	/CS	/RAS	/CAS	/WE	ODT	BA* [3]	A11 -Am	A10	A7 -A9	A3 -A6	A0 -A2	Data* [2]
		0	0	RD	0	1	0	1	0	0	0	0	0	0	0	00000000
			1	D	1	0	0	0	0	0	0	0	0	0	0	_
			2,3	/D, /D	1	1	1	1	0	0	0	0	0	0	0	_
			4	RD	0	1	0	1	0	0	0	0	0	F	0	00110011
			5	D	1	0	0	0	0	0	0	0	0	F	0	_
			6,7	/D, /D	1	1	1	1	0	0	0	0	0	F	0	_
Toggling	Static H	1	8 to 15	Repeat Sub-Loop 0, but BA= 1												
		2	16 to 23	Repeat Sub-Loop 0, but BA= 2												
		3	24 to 31	Repeat Sub-Loop 0, but BA= 3												
		4	32 to 39	Repeat Sub-Loop 0, but BA= 4												
		5	40 to 47	Repeat Sub-Loop 0, but BA= 5												
		6	48 to 55	Repeat Sub-Loop 0, but BA= 6												
		7	56 to 63	Repeat Sub-Loop 0, but BA= 7												

Notes: 1. DM must be driven low all the time. DQS, /DQS are used according to read commands, otherwise MID-LEVEL.

2. Burst sequence driven on each DQ signal by read command. Outside burst operation, DQ signals are MID-LEVEL.

3. BA: BA0 to BA2.

4. Am: m means Most Significant Bit (MSB) of Row address.

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Table 12: IDD4W Measurement-Loop Pattern

CK, /CK	CKE	Sub -Loop	Cycle number	Com-Mand	/CS	/RAS	/CAS	/WE	ODT	BA* [3]	A11 -Am	A10	A7 -A9	A3 -A6	A0 -A2	Data* [2]
		0	0	WR	0	1	0	0	1	0	0	0	0	0	0	00000000
			1	D	1	0	0	0	1	0	0	0	0	0	0	_
			2,3	/D, /D	1	1	1	1	1	0	0	0	0	0	0	_
			4	WR	0	1	0	0	1	0	0	0	0	F	0	00110011
			5	D	1	0	0	0	1	0	0	0	0	F	0	_
			6,7	/D, /D	1	1	1	1	1	0	0	0	0	F	0	_
Toggling	Static H	1	8 to 15	Repeat Sub-Loop 0, but BA= 1												
		2	16 to 23	Repeat Sub-Loop 0, but BA= 2												
		3	24 to 31	Repeat Sub-Loop 0, but BA= 3												
		4	32 to 39	Repeat Sub-Loop 0, but BA= 4												
		5	40 to 47	Repeat Sub-Loop 0, but BA= 5												
		6	48 to 55	Repeat Sub-Loop 0, but BA= 6												
		7	56 to 63	Repeat Sub-Loop 0, but BA= 7												

Notes: 1. DM must be driven low all the time. DQS, /DQS are used according to write commands, otherwise MID-LEVEL.
2. Burst sequence driven on each DQ signal by write command. Outside burst operation, DQ signals are MID-LEVEL.
3. BA: BA0 to BA2.
4. Am: m means Most Significant Bit (MSB) of Row address.

Table 13: IDD5B Measurement-Loop Pattern

CK, /CK	CKE	Sub -Loop	Cycle number	Com-mand	/CS	/RAS	/CAS	/WE	ODT	BA* [3]	A11 -Am	A10	A7 -A9	A3 -A6	A0 -A2	Data* [2]
		0	0	REF	0	0	0	1	0	0	0	0	0	0	0	_
			1, 2	D	1	0	0	0	0	0	0	0	0	0	0	_
			3,4	/D, /D	1	1	1	1	0	0	0	0	0	F	0	_
Toggling	Static H	1	5 to 8	Repeat cycles 1...4, but BA= 1												
			9 to 12	Repeat cycles 1...4, but BA= 2												
			13 to 16	Repeat cycles 1...4, but BA= 3												
			17 to 20	Repeat cycles 1...4, but BA= 4												
			21 to 24	Repeat cycles 1...4, but BA= 5												
			25 to 28	Repeat cycles 1...4, but BA= 6												
			29 to 32	Repeat cycles 1...4, but BA= 7												
		2	33 to nRFC -1	Repeat Sub-Loop 1, until nRFC -1. Truncate, if necessary.												

Notes: 1. DM must be driven low all the time. DQS, /DQS are MID-LEVEL.
2. DQ signals are MID-LEVEL.
3. BA: BA0 to BA2.
4. Am: m means Most Significant Bit (MSB) of Row address.

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Table 14: IDD7 Measurement-Loop Pattern

CK, /CK	CKE	Sub -Loop	Cycle number	Com-mand	/CS	/RAS	/CAS	/WE	ODT	BA*3	A11 -Am	A10	A7 -A9	A3 -A6	A0 -A2	Data*[2]
Toggling	Static H	0	0	ACT	0	0	1	1	0	0	0	0	0	0	0	_
			1	RDA	0	1	0	1	0	0	0	1	0	0	0	00000000
			2	D	1	0	0	0	0	0	0	0	0	0	0	_
			…	Repeat above D Command until nRRD -1												
		1	nRRD	ACT	0	0	1	1	0	1	0	0	0	F	0	_
			nRRD + 1	RDA	0	1	0	1	0	1	0	1	0	F	0	00110011
			nRRD + 2	D	1	0	0	0	0	1	0	0	0	F	0	_
			…	Repeat above D Command until 2 nRRD -1												
		2	2 x nRRD	Repeat Sub-Loop 0, but BA= 2												
		3	3 x nRRD	Repeat Sub-Loop 1, but BA= 3												
		4	4 x nRRD	D	1	0	0	0	0	3	0	0	0	F	0	_
				Assert and repeat above D Command until nFAW -1, if necessary												
		5	nFAW	Repeat Sub-Loop 0, but BA= 4												
		6	nFAW + nRRD	Repeat Sub-Loop 1, but BA= 5												
		7	nFAW + 2 x nRRD	Repeat Sub-Loop 0, but BA= 6												
		8	nFAW + 3 x nRRD	Repeat Sub-Loop 1, but BA= 7												
		9	nFAW	D	1	0	0	0	0	7	0	0	0	F	0	_
			+ 4 x nRRD	Assert and repeat above D Command until 2 x nFAW -1, if necessary												
			2 x nFAW +0	ACT	0	0	1	1	0	0	0	0	0	F	0	_
			2 x nFAW +1	RDA	0	1	0	1	0	0	0	1	0	F	0	00110011
			2 x nFAW D +2		1	0	0	0	0	0	0	0	0	F	0	_
				Repeat above D Command until 2 x nFAW + nRRD -1												
		11	2 x nFAW + nRRD	ACT	0	0	1	1	0	1	0	0	0	0	0	_
			2 x nFAW + nRRD + 1	RDA	0	1	0	1	0	1	0	1	0	0	0	00000000
			2 x nFAW D + nRRD + 2		1	0	0	0	0	1	0	0	0	0	0	_
				Repeat above D Command until 2 x nFAW + 2 x nRRD -1												
		12	2 x nFAW +2 x nRRD	Repeat Sub-Loop 10, but BA= 2												
		13	2 x nFAW + 3 x nRRD	Repeat Sub-Loop 11, but BA= 3												
		14	2 x nFAW D		1	0	0	0	0	3	0	0	0	0	0	_
			+ 4 x nRRD	Assert and repeat above D Command until 3 x nFAW -1, if necessary												
		15	3 x nFAW	Repeat Sub-Loop 10, but BA= 4												
		16	3 x nFAW +nRRD	Repeat Sub-Loop 11, but BA= 5												
		17	3 x nFAW + 2 x nRRD	Repeat Sub-Loop 10, but BA= 6												
		18	3 x nFAW + 3 x nRRD	Repeat Sub-Loop 11, but BA= 7												
		19	3 x nFAW D		1	0	0	0	0	7	0	0	0	0	0	_
			+ 4 x nRRD	Assert and repeat above D Command until 4 x nFAW -1, if necessary												

Notes:
1. DM must be driven low all the time. DQS, /DQS are used according to read commands, otherwise MID-LEVEL.
2. Burst sequence driven on each DQ signal by read command. Outside burst operation, DQ signals are MID-LEVEL.
3. BA: BA0 to BA2.
4. Am: m means Most Significant Bit (MSB) of Row address.

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2. Electrical Specifications(x4/x8/x16)

2.1 DC Characteristics

Table 15: DC Characteristics 1 (TC = 0°C to +85 °C)

Parameter	Symbol	Data rate (Mbps)	x 4 max.	x8 max.	x16 max	Unit	Notes
Operating current (ACT-PRE)	IDD0	1866	70	70	80	mA	
		1600	65	65	75		
		1333	60	60	70		
Operating current (ACT-READ-PRE)	IDD1	1866	85	85	100	mA	
		1600	80	80	95		
		1333	75	75	90		
Precharge power-down standby current	IDD2P1	1866	35	35	35	mA	Fast PD Exit
		1600	35	35	35		
		1333	35	35	35		
	IDD2P0	1866	20	20	20	mA	Slow PD Exit
		1600	20	20	20		
		1333	20	20	20		
Precharge standby current	IDD2N	1866	45	45	45	mA	
		1600	45	45	45		
		1333	45	45	45		
Precharge standby ODT current	IDD2NT	1866	45	45	45	mA	
		1600	45	45	45		
		1333	45	45	45		
Precharge quiet standby current	IDD2Q	1866	45	45	45	mA	
		1600	45	45	45		
		1333	45	45	45		
Active power-down current (Always fast exit)	IDD3P	1866	40	40	40	mA	
		1600	39	39	39		
		1333	37	37	37		
Active standby current	IDD3N	1866	55	55	55	mA	
		1600	55	55	55		
		1333	55	55	55		
Operating current (Burst read operating)	IDD4R	1866	140	145	180	mA	
		1600	120	125	160		
		1333	105	110	145		
Operating current (Burst write operating)	IDD4W	1866	145	150	205	mA	
		1600	125	130	185		
		1333	110	115	170		
Burst refresh current	IDD5B	1866	260	260	260	mA	
		1600	250	250	250		
		1333	250	250	250		
All bank interleave read current	IDD7	1866	210	220	260	mA	
		1600	200	210	250		
		1333	190	200	230		
RESET low current	IDD8	1866/1600/1333	17	17	17	mA	

Self-Refresh Current (TC = 0°C to +85°C)

Parameter	Symbol	Grade	x 4 max.	x8 max.	x16 max.	Unit	Notes
Self-refresh curre normal temperature range	IDD6	1866/1600/1333	22	22	22	mA	
Self-refresh current. extended temperature range	IDD6E	1866/1600/1333	25	25	25	mA	
Auto self-refresh current (Optional)	IDD6TC	1866/1600/1333	—	—	—	mA	

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2.2 Pin Capacitance

Table 16: Pin Capacitance [DDR3(L)-1333 to 1600] (TC = 25°C)

		DDR3(L)-1866		DDR3(L)-1600		DDR3(L)-1333			
Parameter	Symbol	Min	Max	Min	Max	Min	Max	Units	Notes
Input/output capacitance	CIO	1.4	2.2	1.4	2.2	1.4	2.3	pF	1, 2
Input capacitance, CK and /CK	CCK	0.8	1.4	0.8	1.4	0.8	1.4	pF	2
Input capacitance delta, CK and /CK	CDCK	0	0.15	0	0.15	0	0.15	pF	2, 3
Input/output capacitance delta, DQS and /DQS	CDDQS	0	0.15	0	0.15	0	0.15	pF	2, 4
Input capacitance, (control, address, command, input-only pins)	CI	0.75	1.2	0.75	1.2	0.75	1.3	pF	2, 5
Input capacitance delta, (All control input-only pins)	CDI_CTRL _	-0.4	0.2	-0.4	0.2	-0.4	0.2	pF	2, 6, 7
Input capacitance delta, (All addres/command input-only pins)	CDI_ADD_ CMD	-0.4	0.4	-0.4	0.4	-0.4	0.4	pF	2, 8, 9
Input/output capacitance delta, DQ,DM, DQS, /DQS, TDQS, /TDQS	CDIO	-0.5	0.3	-0.5	0.3	-0.5	0.3	pF	2, 10
Input/output capacitance of ZQ pin	CZQ	_	3	_	3	_	3	pF	2, 11

Notes:
1. Although the DM, TDQS and /TDQS pins have different functions, the loading matches DQ and DQS.
2. VDD, VDDQ, VSS, VSSQ applied and all other pins floating (except the pin under test, CKE, /RESET and ODT as necessary). VDD = VDDQ = 1.35V, VBIAS=VDD/2 and ondie termination off.
3. Absolute value of CCK-C/CK.
4. Absolute value of CIO(DQS)-CIO(/DQS).
5. CI applies to ODT, /CS, CKE, A0-A15, BA0-BA2, /RAS, /CAS and /WE.
6. CDI_CTRL applies to ODT, /CS and CKE.
7. CDI_CTRL = CI(CTRL) -0.5 x (CI(CK)+CI(/CK)).
8. CDI_ADD_CMD applies to A0-A15, BA0-BA2, /RAS, /CAS and /WE.
9. CDI_ADD_CMD = CI(ADD_CMD) -0.5 x (CI(CK)+CI(/CK)).
10. CDIO=CIO(DQ,DM) -0.5 x (CIO(DQS)+CIO(/DQS)).
11. Maximum external load capacitance on ZQ pin: 5pF.

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2.2 Standard Speed Bins

Table 17: DDR3(L)-1866 Speed Bins

Speed Bin		DDR3(L)-1866			
CL-tRCD-tRP		13-13-13			
	/CAS write latency	min	max	Unit	Notes
tAA		13.91	20	ns	
tRCD		13.91	_	ns	
tRP		13.91	_	ns	
tRC		47.91	_	ns	
tRAS		34.0	9 x tREFI	ns	8
tCK(avg) @CL=5	CWL = 5	3.0	3.3	ns	1, 2, 3, 8
	CWL = 6, 7, 8,9	Reserved	Reserved	ns	4
tCK(avg) @CL=6	CWL = 5	2.5	3.3	ns	1, 2, 3, 8
	CWL = 6	Reserved	Reserved	ns	4
	CWL = 7, 8,9	Reserved	Reserved	ns	4
tCK(avg) @CL=7	CWL = 5	Reserved	Reserved	ns	4
	CWL = 6	1.875	2.5	ns	1, 2, 3, 8
	CWL = 7,8,9	Reserved	Reserved	ns	4
tCK(avg) @CL=8	CWL = 5	Reserved	Reserved	ns	4
	CWL = 6	1.875	2.5	ns	1, 2, 3, 8
	CWL = 7	Reserved	Reserved	ns	4
	CWL = 8,9	Reserved	Reserved	ns	4
tCK(avg) @CL=9	CWL = 5, 6	Reserved	Reserved	ns	4
	CWL= 7	1.5	1.875	ns	1, 2, 3, 8
	CWL= 8	Reserved	Reserved	ns	4
	CWL= 9	Reserved	Reserved	ns	4
tCK(avg) @CL=10	CWL = 5, 6	Reserved	Reserved	ns	4
	CWL= 7	1.5	1.875	ns	1,2,3,8
	CWL= 8	Reserved	Reserved	ns	4
tCK(avg) @CL=11	CWL = 5, 6, 7	Reserved	Reserved	ns	4
	CWL= 8	1.25	1.5	ns	1, 2, 3, 8
	CWL= 9	Reserved	Reserved	ns	4
tCK(avg) @CL=12	CWL = 5, 6, 7,8	Reserved	Reserved	ns	4
	CWL= 9	Reserved	Reserved	ns	4
tCK(avg) @CL=13	CWL = 5, 6, 7,8	Reserved	Reserved	ns	4
	CWL= 9	1.07	1.25	ns	4
Supported CL settings			5, 6, 7, 8, 9, 10, 11,13	nCK	1,2,3,8
Supported CWL settings			5, 6, 7, 8,9	nCK	

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Table 18: DDR3(L)-1600 Speed Bins

Speed Bin		DDR3(L)-1600			
CL-tRCD-tRP		11-11-11			
Symbol	/CAS write latency	min	max	Unit	Notes
tAA		13.75 (13.125)	20	ns	9
tRCD		13.75 (13.125)	_	ns	9
tRP		13.75 (13.125)	_	ns	9
tRC		48.75 (48.125)	_	ns	9
tRAS		35	9 x tREFI	ns	8
tCK(avg) @CL=5	CWL = 5	3.0	3.3	ns	1, 2, 3, 4, 7, 10
	CWL = 6, 7, 8	Reserved	Reserved	ns	4
tCK(avg) @CL=6	CWL = 5	2.5	3.3	ns	1, 2, 3, 7
	CWL = 6	Reserved	Reserved	ns	4
	CWL = 7, 8	Reserved	Reserved	ns	4
tCK(avg) @CL=7	CWL = 5	Reserved	Reserved	ns	4
	CWL = 6	1.875	< 2.5	ns	1, 2, 3, 4, 7
	CWL = 7	Reserved	Reserved	ns	4
	CWL = 8	Reserved	Reserved	ns	4
tCK(avg) @CL=8	CWL = 5	Reserved	Reserved	ns	4
	CWL = 6	1.875	< 2.5	ns	1, 2, 3, 7
	CWL = 7	Reserved	Reserved	ns	4
	CWL = 8	Reserved	Reserved	ns	4
tCK(avg) @CL=9	CWL = 5, 6	Reserved	Reserved	ns	4
	CWL= 7	1.5	< 1.875	ns	1, 2, 3, 4, 7
	CWL= 8	Reserved	Reserved	ns	4
tCK(avg) @CL=10	CWL = 5, 6	Reserved	Reserved	ns	4
	CWL= 7	1.5	< 1.875	ns	1, 2, 3, 7
	CWL= 8	Reserved	Reserved	ns	4
tCK(avg) @CL=11	CWL = 5, 6, 7	Reserved	Reserved	ns	4
	CWL= 8	1.25	< 1.5	ns	1,2,3
Supported CL settings		5, 6, 7, 8, 9, 10, 11		nCK	
Supported CWL settings		5, 6, 7, 8		nCK	

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Table 19 DDR3(L)-1333 Speed Bins

Speed Bin		DDR3(L)-1333			
CL-tRCD-tRP		9-9-9			
Symbol	/CAS write latency	min	max	Unit	Notes
tAA		13.5 (13.125)	20	ns	9
tRCD		13.5 (13.125)	_	ns	9
tRP		13.5 (13.125)	_	ns	9
tRC		49.5 (49.125)	_	ns	9
tRAS		36	9 x tREFI	ns	8
tCK(avg) @CL=5	CWL = 5	3.0	3.3	ns	1, 2, 3, 4, 6, 10
	CWL = 6, 7	Reserved	Reserved	ns	4
tCK(avg) @CL=6	CWL = 5	2.5	3.3	ns	1, 2, 3, 6
	CWL = 6	Reserved	Reserved	ns	4
	CWL = 7	Reserved	Reserved	ns	4
tCK(avg) @CL=7	CWL = 5	Reserved	Reserved	ns	4
	CWL = 6	1.875	< 2.5	ns	1, 2, 3, 4, 6
	CWL = 7	Reserved	Reserved	ns	4
tCK(avg) @CL=8	CWL = 5	Reserved	Reserved	ns	4
	CWL = 6	1.875	< 2.5	ns	1, 2, 3, 6
	CWL = 7	Reserved	Reserved	ns	4
tCK(avg) @CL=9	CWL = 5, 6	Reserved	Reserved	ns	4
	CWL= 7	1.5	< 1.875	ns	1, 2, 3, 4
tCK(avg) @CL=10	CWL = 5, 6	Reserved	Reserved	ns	4
	CWL= 7	1.5	< 1.875	ns	1, 2, 3
Supported CL settings		5, 6, 7, 8, 9, 10		nCK	
Supported CWL settings		5, 6, 7		nCK	

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Notes:
1. The CL setting and CWL setting result in tCK(avg)min and tCK(avg)max requirements. When making a selection of tCK(avg), both need to be fulfilled: Requirements from CL setting as well as requirements from CWL setting.
2. tCK(avg)min limits: Since /CAS latency is not purely analog - data and strobe output are synchronized by the DLL - all possible intermediate frequencies may not be guaranteed. An application should use the next smaller JEDEC standard tCK(avg) value (3.0, 2.5, 1.875, 1.5, or 1.25ns) when calculating CL(nCK) = tAA(ns) / tCK(avg)(ns), rounding up to the next 'Supported CL'.
3. tCK(avg)max limits: Calculate tCK(avg) + tAA(max)/CL selected and round the resulting tCK(avg) down to the next valid speed bin (i.e. 3.3ns or 2.5ns or 1.875ns or 1.25ns). This result is tCK(avg)max corresponding to CL selected.
4. Reserved' settings are not allowed. User must program a different value.
5. Any DDR3(L)-1333 speed bin also supports functional operation at lower frequencies as shown in the table DDR3(L)-1333 Speed Bins which is not subject to production tests but verified by design/characterization.
6. Any DDR3(L)-1600 speed bin also supports functional operation at lower frequencies as shown in the table DDR3(L)-1600 Speed Bins which is not subject to production tests but verified by design/characterization.
7. tREFI depends on operating case temperature (TC).
8. For devices supporting optional down binning to CL = 7 and CL = 9, tAA/tRCD/tRP(min) must be 13.125 ns or lower. SPD settings must be programmed to match.
9. DDR3(L)-800 AC timing apply if DRAM operates at lower than 800 MT/s data rate.

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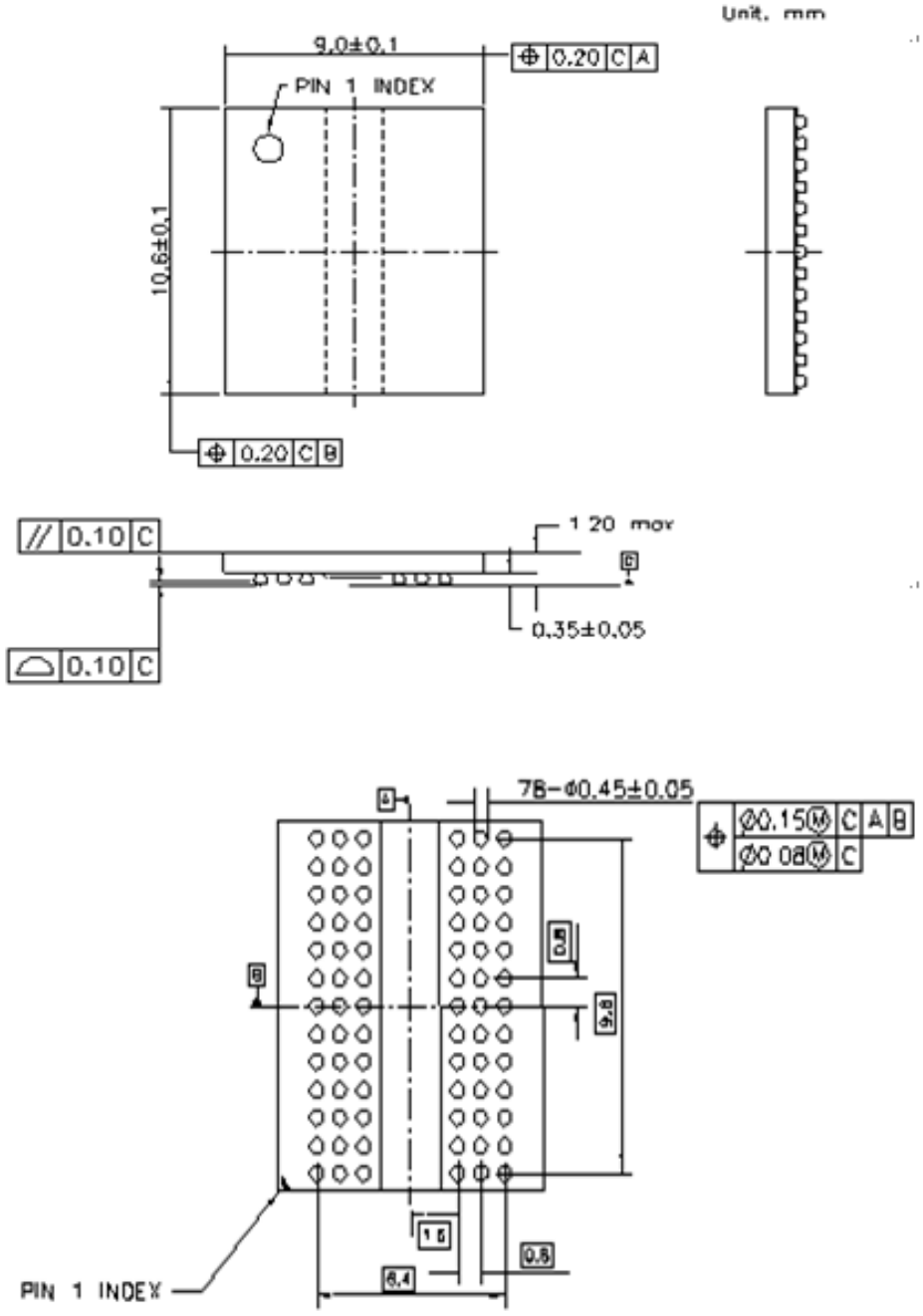
3. Package Drawing

3.1 78-ball FBGA

Solder ball: Lead free (Sn-Ag-Cu)



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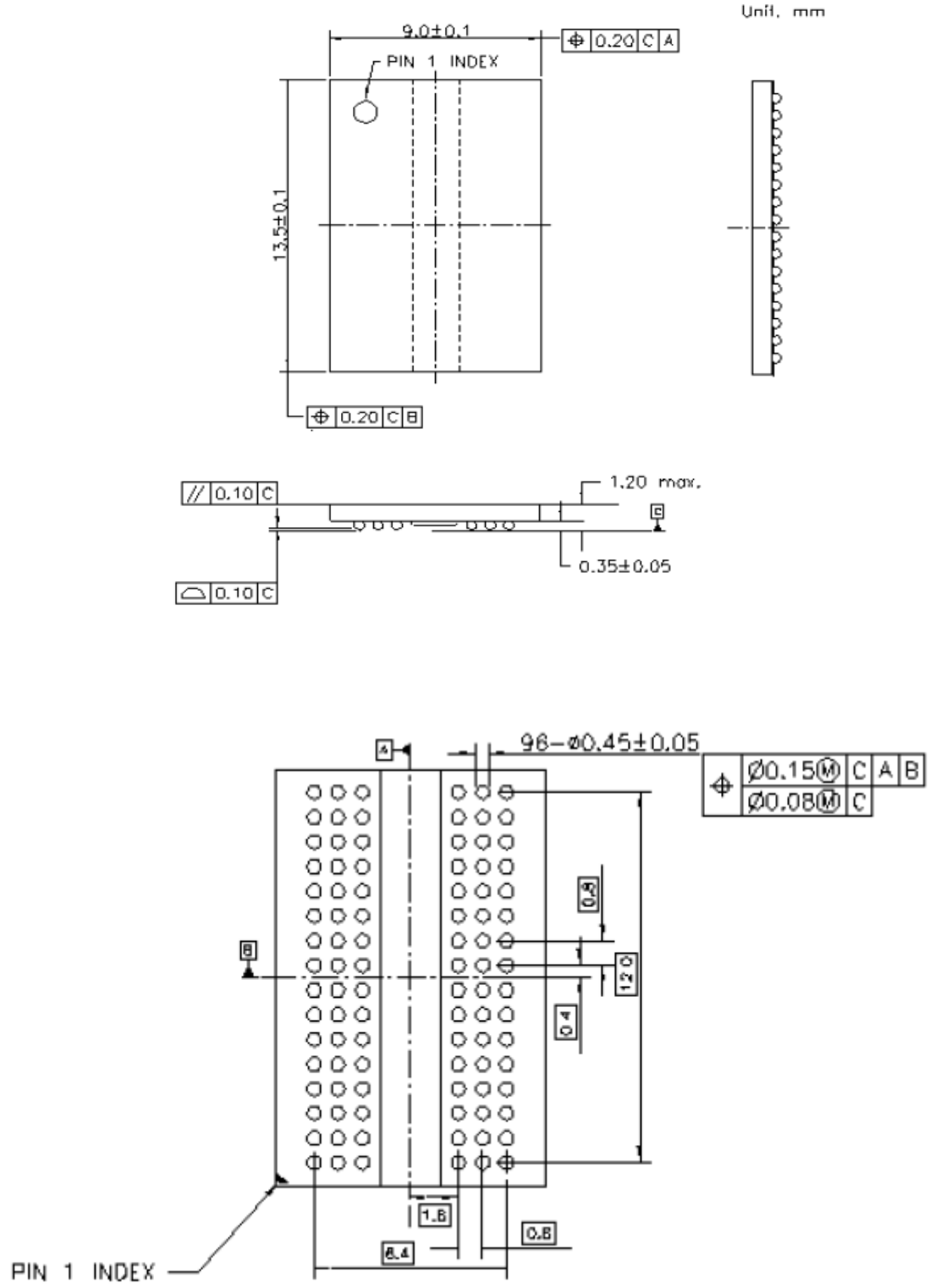
3.2 96-ball FBGA

Solder ball: Lead free (Sn-Ag-Cu)



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4. Recommended Soldering Conditions

Please consult with our sales offices for soldering conditions of the 4G bits DDR3(L) SDRAM.

Type of Surface Mount Device

P3P4GF2BLF, P3P4GF3BLF:78-ball FBGA < Lead free (Sn-Ag-Cu) >
P3P4GF4BLF:96-ball FBGA < Lead free (Sn-Ag-Cu) >

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NOTES FOR CMOS DEVICES

① PRECAUTION AGAINST ESD FOR MOS DEVICES

Exposing the MOS devices to a strong electric field can cause destruction of the gate oxide and ultimately degrade the MOS devices operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it, when once it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. MOS devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. MOS devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor MOS devices on it.

② HANDLING OF UNUSED INPUT PINS FOR CMOS DEVICES

No connection for CMOS devices input pins can be a cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to VDD or GND with a resistor, if it is considered to have a possibility of being an output pin. The unused pins must be handled in accordance with the related specifications.

③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Power-on does not necessarily define initial status of MOS devices. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the MOS devices with reset function have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. MOS devices are not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for MOS devices having reset function.

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