

1.5V DDR3 SDRAM UDIMM

NTCKF1600DD3-4GB

NTCKF1600DD3-8GB

Features

- DDR3 functionality and operations supported as defined in the component data sheet
- 240-pin, unbuffered dual in-line memory module (UDIMM)
- Fast data transfer rates: PC3-14900, PC3-12800, or PC3-10600
- 4GB, 8GB
- $V_{DD} = V_{DDQ} = 1.5V$
- Backward-compatible to $V_{DD} = V_{DDQ} = 1.5V \pm 0.75V$
- $V_{DDSPD} = 3.0-3.6V$
- Reset pin for improved system stability
- Nominal and dynamic on-die termination (ODT) for data, strobe, and mask signals
- Dual-rank
- Fixed burst chop (BC) of 4 and burst length (BL) of 8 via the mode register set (MRS)
- Adjustable data-output drive strength
- Serial presence-detect (SPD) EEPROM
- Gold edge contacts
- Halogen-free
- Addresses are mirrored for second rank
- Fly-by topology
- Terminated control, command, and address bus

Figure 1: 240-Pin UDIMM (MO-269 R/C-B)

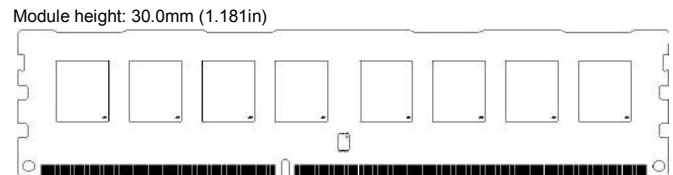
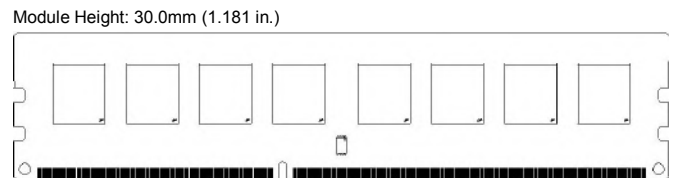


Figure 2: 240-Pin UDIMM (MO-269 R/C-B1)



Options

- Operating temperature
 - Commercial ($0^{\circ}C \leq T_A \leq +70^{\circ}C$)
- Package
 - 240-pin DIMM (halogen-free)
- Frequency/CAS latency
 - 1.07ns @ CL = 13 (DDR3-1866)
 - 1.25ns @ CL = 11 (DDR3-1600)
 - 1.5ns @ CL = 9 (DDR3-1333)

Marking

None
Z
-1G9
-1G6
-1G4



Pin Assignments

Table 5: Pin Assignments

240-Pin UDIMM Front								240-Pin UDIMM Back							
Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol
1	REFDQ	31	DQ25	61	A2	91	DQ41	121	V _{SS}	151	V _{SS}	181	A1	211	V _{SS}
2	V _{SS}	32	V _{SS}	62	V _{DD}	92	V _{SS}	122	DQ4	152	DM3	182	V _{DD}	212	DM5
3	DQ0	33	DQS3#	63	CK1	93	DQS5#	123	DQ5	153	NC	183	V _{DD}	213	NC
4	DQ1	34	DQS3	64	CK1#	94	DQS5	124	V _{SS}	154	V _{SS}	184	CK0	214	V _{SS}
5	V _{SS}	35	V _{SS}	65	V _{DD}	95	V _{SS}	125	DM0	155	DQ30	185	CK0#	215	DQ46
6	DQS0#	36	DQ26	66	V _{DD}	96	DQ42	126	NC	156	DQ31	186	V _{DD}	216	DQ47
7	DQS0	37	DQ27	67	REFCA	97	DQ43	127	V _{SS}	157	V _{SS}	187	NC	217	V _{SS}
8	V _{SS}	38	V _{SS}	68	NC	98	V _{SS}	128	DQ6	158	NC	188	A0	218	DQ52
9	DQ2	39	NC	69	V _{DD}	99	DQ48	129	DQ7	159	NC	189	V _{DD}	219	DQ53
10	DQ3	40	NC	70	A10	100	DQ49	130	V _{SS}	160	V _{SS}	190	BA1	220	V _{SS}
11	V _{SS}	41	V _{SS}	71	BA0	101	V _{SS}	131	DQ12	161	NC	191	V _{DD}	221	DM6
12	DQ8	42	NC	72	V _{DD}	102	DQS6#	132	DQ13	162	NC	192	RAS#	222	NC
13	DQ9	43	NC	73	WE#	103	DQS6	133	V _{SS}	163	V _{SS}	193	S0#	223	V _{SS}
14	V _{SS}	44	V _{SS}	74	CAS#	104	V _{SS}	134	DM1	164	NC	194	V _{DD}	224	DQ54
15	DQS1#	45	NC	75	V _{DD}	105	DQ50	135	NC	165	NC	195	ODT0	225	DQ55
16	DQS1	46	NC	76	S1#	106	DQ51	136	V _{SS}	166	V _{SS}	196	A13	226	V _{SS}
17	V _{SS}	47	V _{SS}	77	ODT1	107	V _{SS}	137	DQ14	167	NC	197	V _{DD}	227	DQ60
18	DQ10	48	NC	78	V _{DD}	108	DQ56	138	DQ15	168	RESET#	198	NC	228	DQ61
19	DQ11	49	NC	79	NC	109	DQ57	139	V _{SS}	169	CKE1	199	V _{SS}	229	V _{SS}
20	V _{SS}	50	CKE0	80	V _{SS}	110	V _{SS}	140	DQ20	170	V _{DD}	200	DQ36	230	DM7
21	DQ16	51	V _{DD}	81	DQ32	111	DQS7#	141	DQ21	171	NF/A15 ¹	201	DQ37	231	NC
22	DQ17	52	BA2	82	DQ33	112	DQS7	142	V _{SS}	172	A14	202	V _{SS}	232	V _{SS}
23	V _{SS}	53	NC	83	V _{SS}	113	V _{SS}	143	DM2	173	V _{DD}	203	DM4	233	DQ62
24	DQS2#	54	V _{DD}	84	DQS4#	114	DQ58	144	NC	174	A12	204	NC	234	DQ63
25	DQS2	55	A11	85	DQS4	115	DQ59	145	V _{SS}	175	A9	205	V _{SS}	235	V _{SS}
26	V _{SS}	56	A7	86	V _{SS}	116	V _{SS}	146	DQ22	176	V _{DD}	206	DQ38	236	V _{DDSPD}
27	DQ18	57	V _{DD}	87	DQ34	117	SA0	147	DQ23	177	A8	207	DQ39	237	SA1
28	DQ19	58	A5	88	DQ35	118	SCL	148	V _{SS}	178	A6	208	V _{SS}	238	SDA
29	V _{SS}	59	A4	89	V _{SS}	119	SA2	149	DQ28	179	V _{DD}	209	DQ44	239	V _{SS}
30	DQ24	60	V _{DD}	90	DQ40	120	V _{TT}	150	DQ29	180	A3	210	DQ45	240	V _{TT}

Note: 1. Pin 171 is NF for 4GB; A15 for 8GB.



Pin Descriptions

The pin description table below is a comprehensive list of all possible pins for all DDR3 modules. All pins listed may not be supported on this module. See Pin Assignments for information specific to this module.

Table 6: Pin Descriptions

Symbol	Type	Description
Ax	Input	Address inputs: Provide the row address for ACTIVE commands, and the column address and auto precharge bit (A10) for READ/WRITE commands, to select one location out of the memory array in the respective bank. A10 sampled during a PRECHARGE command determines whether the PRECHARGE applies to one bank (A10 LOW, bank selected by BAx) or all banks (A10 HIGH). The address inputs also provide the op-code during a LOAD MODE command. See the Pin Assignments table for density-specific addressing information.
BAx	Input	Bank address inputs: Define the device bank to which an ACTIVE, READ, WRITE, or PRECHARGE command is being applied. BA define which mode register (MR0, MR1, MR2, or MR3) is loaded during the LOAD MODE command.
CKx, CKx#	Input	Clock: Differential clock inputs. All control, command, and address input signals are sampled on the crossing of the positive edge of CK and the negative edge of CK#.
CKEx	Input	Clock enable: Enables (registered HIGH) and disables (registered LOW) internal circuitry and clocks on the DRAM.
DMx	Input	Data mask (x8 devices only): DM is an input mask signal for write data. Input data is masked when DM is sampled HIGH, along with that input data, during a write access. Although DM pins are input-only, DM loading is designed to match that of the DQ and DQS pins.
ODTx	Input	On-die termination: Enables (registered HIGH) and disables (registered LOW) termination resistance internal to the DDR3 SDRAM. When enabled in normal operation, ODT is only applied to the following pins: DQ, DQS, DQS#, DM, and CB. The ODT input will be ignored if disabled via the LOAD MODE command.
Par_In	Input	Parity input: Parity bit for Ax, RAS#, CAS#, and WE#.
RAS#, CAS#, WE#	Input	Command inputs: RAS#, CAS#, and WE# (along with S#) define the command being entered.
RESET#	Input (LVCMOS)	Reset: RESET# is an active LOW asynchronous input that is connected to each DRAM and the registering clock driver. After RESET# goes HIGH, the DRAM must be reinitialized as though a normal power-up was executed.
Sx#	Input	Chip select: Enables (registered LOW) and disables (registered HIGH) the command decoder.
SAx	Input	Serial address inputs: Used to configure the temperature sensor/SPD EEPROM address range on the I ² C bus.
SCL	Input	Serial clock for temperature sensor/SPD EEPROM: Used to synchronize communication to and from the temperature sensor/SPD EEPROM on the I ² C bus.
CBx	I/O	Check bits: Used for system error detection and correction.
DQx	I/O	Data input/output: Bidirectional data bus.
DQSx, DQSx#	I/O	Data strobe: Differential data strobes. Output with read data; edge-aligned with read data; input with write data; center-aligned with write data.



4GB, 8GB (x64, DR) 240-Pin 1.5V DDR3 UDIMM Pin Assignments

Table 6: Pin Descriptions (Continued)

Symbol	Type	Description
SDA	I/O	Serial data: Used to transfer addresses and data into and out of the temperature sensor/SPD EEPROM on the I ² C bus.
TDQSx, TDQSx#	Output	Redundant data strobe (x8 devices only): TDQS is enabled/disabled via the LOAD MODE command to the extended mode register (EMR). When TDQS is enabled, DM is disabled and TDQS and TDQS# provide termination resistance; otherwise, TDQS# are no function.
Err_Out#	Output (open drain)	Parity error output: Parity error found on the command and address bus.
EVENT#	Output (open drain)	Temperature event: The EVENT# pin is asserted by the temperature sensor when critical temperature thresholds have been exceeded.
V _{DD}	Supply	Power supply: 1.5V backward-compatible to 1.5V (1.425–1.575V). The component VDD and VDDQ are connected to the module VDD.
V _{DDSPD}	Supply	Temperature sensor/SPD EEPROM power supply: 3.0–3.6V.
V _{REFCA}	Supply	Reference voltage: Control, command, and address VDD/2.
V _{REFDQ}	Supply	Reference voltage: DQ, DM VDD/2.
V _{SS}	Supply	Ground.
V _{TT}	Supply	Termination voltage: Used for control, command, and address VDD/2.
NC	-	No connect: These pins are not connected on the module.
NF	-	No function: These pins are connected within the module, but provide no functionality.



DQ Map

Table 7: Component-to-Module DQ Map

Component Reference Number	Component DQ	Module DQ	Module Pin Number	Component Reference Number	Component DQ	Module DQ	Module Pin Number
U1	0	2	9	U2	0	10	18
	1	5	123		1	13	132
	2	7	129		2	15	138
	3	1	4		3	9	13
	4	6	128		4	14	137
	5	4	122		5	12	131
	6	3	10		6	11	19
	7	0	3		7	8	12
U3	0	18	27	U4	0	26	36
	1	21	141		1	29	150
	2	23	147		2	31	156
	3	17	22		3	25	31
	4	22	146		4	30	155
	5	20	140		5	28	149
	6	19	28		6	27	37
	7	16	21		7	24	30
U5	0	34	87	U6	0	42	96
	1	37	201		1	45	210
	2	39	207		2	47	216
	3	33	82		3	41	91
	4	38	206		4	46	215
	5	36	200		5	44	209
	6	35	88		6	43	97
	7	32	81		7	40	90
U7	0	50	105	U8	0	58	114
	1	53	219		1	61	228
	2	55	225		2	63	234
	3	49	100		3	57	109
	4	54	224		4	62	233
	5	52	218		5	60	227
	6	51	106		6	59	115
	7	48	99		7	56	108



Table 7: Component-to-Module DQ Map (Continued)

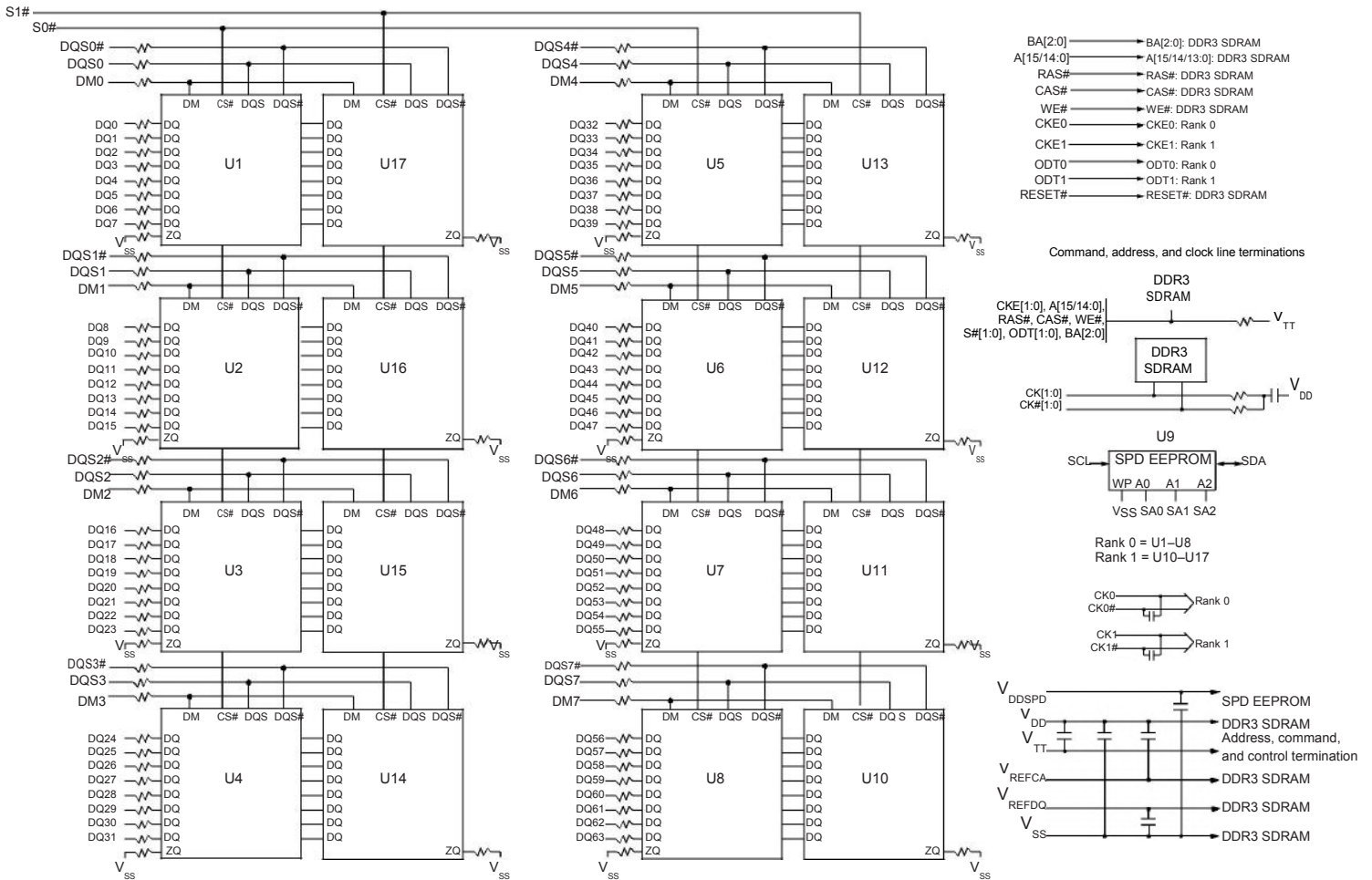
Component Reference Number	Component DQ	Module DQ	Module Pin Number	Component Reference Number	Component DQ	Module DQ	Module Pin Number
U10	0	61	228	U11	0	53	219
	1	58	114		1	50	105
	2	57	109		2	49	100
	3	63	234		3	55	225
	4	56	108		4	48	99
	5	59	115		5	51	106
	6	60	227		6	52	218
	7	62	233		7	54	224
U12	0	45	210	U13	0	37	201
	1	42	96		1	34	87
	2	41	91		2	33	82
	3	47	216		3	39	207
	4	40	90		4	32	81
	5	43	97		5	35	88
	6	44	209		6	36	200
	7	46	215		7	38	206
U14	0	29	150	U15	0	21	141
	1	26	36		1	18	27
	2	25	31		2	17	22
	3	31	156		3	23	147
	4	24	30		4	16	21
	5	27	37		5	19	28
	6	28	149		6	20	140
	7	30	155		7	22	146
U16	0	13	132	U17	0	5	123
	1	10	18		1	2	9
	2	9	13		2	1	4
	3	15	138		3	7	129
	4	8	12		4	0	3
	5	11	19		5	3	10
	6	12	131		6	4	122
	7	14	137		7	6	128



4GB, 8GB (x64, DR) 240-Pin 1.5V DDR3 UDIMM Functional Block Diagram

Functional Block Diagram

Figure 3: Functional Block Diagram



Note: 1. The ZQ ball on each DDR3 component is connected to an external 240Ω ±1% resistor that is tied to ground. Used for the calibration of the component's on-die termination and output driver.



General Description

DDR3 SDRAM modules are high-speed, CMOS dynamic random access memory modules that use internally configured 8-bank DDR3 SDRAM devices. DDR3 SDRAM modules use DDR architecture to achieve high-speed operation. DDR3 architecture is essentially an $8n$ -prefetch architecture with an interface designed to transfer two data words per clock cycle at the I/O pins. A single read or write access for the DDR3 SDRAM module effectively consists of a single $8n$ -bit-wide, one-clock-cycle data transfer at the internal DRAM core and eight corresponding n -bit-wide, one-half-clock-cycle data transfers at the I/O pins.

DDR3 modules use two sets of differential signals: DQS, DQS# to capture data and CK and CK# to capture commands, addresses, and control signals. Differential clocks and data strobes ensure exceptional noise immunity for these signals and provide precise crossing points to capture input signals.

Fly-By Topology

DDR3 modules use faster clock speeds than earlier DDR technologies, making signal quality more important than ever. For improved signal quality, the clock, control, command, and address buses have been routed in a fly-by topology, where each clock, control, command, and address pin on each DRAM is connected to a single trace and terminated (rather than a tree structure, where the termination is off the module near the connector). Inherent to fly-by topology, the timing skew between the clock and DQS signals can be easily accounted for by using the write-leveling feature of DDR3.



4GB, 8GB (x64, DR) 240-Pin 1.5V DDR3 UDIMM Electrical Specifications

Electrical Specifications

Stresses greater than those listed may cause permanent damage to the module. This is a stress rating only, and functional operation of the module at these or any other conditions outside those indicated in each device's data sheet is not implied. Exposure to absolute maximum rating conditions for extended periods may adversely affect reliability.

Table 8: Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Units
V_{DD}	VDD supply voltage relative to VSS	-0.4	1.975	V
V_{IN}, V_{OUT}	Voltage on any pin relative to VSS	-0.4	1.975	V

Table 9: Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units	Notes	
V_{DD}	VDD supply voltage	1.283	1.35	1.45	V		
		1.425	1.5	1.575	V	1	
I_{VTT}	Termination reference current from VTT	-600	-	600	mA		
V_{TT}	Termination reference voltage – command address bus	$0.49 \times V_{DD}$	$0.5 \times V_{DD}$	$0.51 \times V_{DD}$	V	2	
I_I	Input leakage current; Any input $0V \leq V_{IN} \leq V_{DD}$; VREF input $0V \leq V_{IN} \leq 0.95V$ (All other pins not under test = 0V)	Address inputs RAS#, CAS#, WE#, BA	-32	0	32	μA	
		S#, CKE, ODT, CK, CK#	-16	0	16		
		DM	-4	0	4		
I_{OZ}	Output leakage current; $0V \leq V_{OUT} \leq V_{DDQ}$; DQs and ODT are disabled	DQ, DQS, DQS#	-10	0	10	μA	
I_{VREF}	VREF supply leakage current; $V_{REF} = V_{DD}/2$ or $V_{REFCA} = V_{DD}/2$ (All other pins not under test = 0V)		-16	0	16	μA	
T_A	Module ambient operating temperature	Commercial	0	-	70	$^{\circ}C$	3, 4
T_C	DDR3 SDRAM component case operating temperature	Commercial	0	-	95	$^{\circ}C$	3, 4, 5

Notes: 1. Module is backward-compatible with 1.5V operation. Refer to device specification for details and operation guidance.

2. VTT termination voltage in excess of the stated limit will adversely affect the command and address signals' voltage margin and will reduce timing margins.

3. TA and TC are simultaneous requirements.

4. For further information, refer to technical note TN-00-08: "Thermal Applications," available on Micron's Web site.

5. The refresh rate is required to double when $85^{\circ}C < T_C \leq 95^{\circ}C$.



IDD Specifications

Table 11: DDR3 IDD Specifications and Conditions – 4GB (Die Revision K)

Values are for the DDR3 SDRAM only and are computed from values specified in the 1.5V 2Gb component data sheet

Parameter	Symbol	1600	1333	Units
Operating current 0: One bank ACTIVATE-to-PRECHARGE	IDD0 ¹	408	400	mA
Operating current 1: One bank ACTIVATE-to-READ-to-PRECHARGE	IDD1 ¹	512	496	mA
Precharge power-down current: Slow exit	IDD2P0 ²	192	192	mA
Precharge power-down current: Fast exit	IDD2P1 ²	224	224	mA
Precharge quiet standby current	IDD2Q ²	320	320	mA
Precharge standby current	IDD2N ²	336	336	mA
Precharge standby ODT current	IDD2NT ¹	344	328	mA
Active power-down current	IDD3P ²	336	336	mA
Active standby current	IDD3N ²	512	480	mA
Burst read operating current	IDD4R ¹	848	752	mA
Burst write operating current	IDD4W ¹	872	776	mA
Refresh current	IDD5B ¹	1536	1528	mA
Self refresh temperature current: MAX T _C = 85°C	IDD6 ²	192	192	mA
Self refresh temperature current (SRT-enabled): MAX T _C = 95°C	IDD6ET ²	240	240	mA
All banks interleaved read current	IDD7 ¹	1344	1296	mA
Reset current	IDD8 ²	224	224	mA

Notes: 1. One module rank in the active IDD; the other rank in IDD2P0 (slow exit). 2. All ranks in this IDD condition.



4GB, 8GB (x64, DR) 240-Pin 1.5V DDR3 UDIMM IDD Specifications

Table 12: DDR3 IDD Specifications and Conditions – 8GB (Die Revision E)

Values are for the DDR3 SDRAM only and are computed from values specified in the 1.5V 4Gb component data sheet

Parameter	Symbol	1866	1600	Units
Operating current 0: One bank ACTIVATE-to-PRECHARGE	I _{DD0} ¹	640	584	mA
Operating current 1: One bank ACTIVATE-to-READ-to-PRECHARGE	I _{DD1} ¹	704	672	mA
Precharge power-down current: Slow exit	I _{DD2P0} ²	288	288	mA
Precharge power-down current: Fast exit	I _{DD2P1} ²	592	512	mA
Precharge quiet standby current	I _{DD2Q} ²	560	512	mA
Precharge standby current	I _{DD2N} ²	560	512	mA
Precharge standby ODT current	I _{DD2NT} ¹	480	456	mA
Active power-down current	I _{DD3P} ²	656	608	mA
Active standby current	I _{DD3N} ²	656	608	mA
Burst read operating current	I _{DD4R} ¹	1536	1400	mA
Burst write operating current	I _{DD4W} ¹	1272	1144	mA
Refresh current	I _{DD5B} ¹	2080	2024	mA
Self refresh temperature current: MAX T _C = 85°C	I _{DD6} ²	320	320	mA
Self refresh temperature current (SRT-enabled): MAX T _C = 95°C	I _{DD6ET} ²	400	400	mA
All banks interleaved read current	I _{DD7} ¹	2152	1904	mA
Reset current	I _{DD8} ²	320	320	mA

Notes: 1. One module rank in the active IDD; the other rank in IDD2P0 (slow exit). 2.
All ranks in this IDD condition.



4GB, 8GB (x64, DR) 240-Pin 1.5V DDR3 UDIMM
IDD Specifications

Table 13: DDR3 IDD Specifications and Conditions – 8GB (Die Revision N)

Values are for the DDR3 SDRAM only and are computed from values specified in the 1.5V 4Gb component data sheet

Parameter	Symbol	1866	1600	Units
Operating current 0: One bank ACTIVATE-to-PRECHARGE	I _{DD0} ¹	456	440	mA
Operating current 1: One bank ACTIVATE-to-READ-to-PRECHARGE	I _{DD1} ¹	576	552	mA
Precharge power-down current: Slow exit	I _{DD2P0} ²	128	128	mA
Precharge power-down current: Fast exit	I _{DD2P1} ²	256	224	mA
Precharge quiet standby current	I _{DD2Q} ²	416	384	mA
Precharge standby current	I _{DD2N} ²	416	384	mA
Precharge standby ODT current	I _{DD2NT} ¹	304	288	mA
Active power-down current	I _{DD3P} ²	448	416	mA
Active standby current	I _{DD3N} ²	512	480	mA
Burst read operating current	I _{DD4R} ¹	904	824	mA
Burst write operating current	I _{DD4W} ¹	904	824	mA
Refresh current	I _{DD5B} ²	1504	1464	mA
Self refresh temperature current: MAX T _C = 85°C	I _{DD6} ²	192	192	mA
Self refresh temperature current (SRT-enabled): MAX T _C = 95°C	I _{DD6ET} ²	256	256	mA
All banks interleaved read current	I _{DD7} ¹	1184	1104	mA
Reset current	I _{DD8} ²	160	160	mA

Notes: 1. One module rank in the active IDD; the other rank in I_{DD2P0} (slow exit). 2. All ranks in this IDD condition.



4GB, 8GB (x64, DR) 240-Pin 1.5V DDR3 UDIMM IDD Specifications

Table 14: DDR3 IDD Specifications and Conditions – 8GB (Die Revision P)

Values are for the DDR3 SDRAM only and are computed from values specified in the 1.5V 4Gb (512 Meg x 8) component data sheet

Parameter	Symbol	1866	1600	Units
Operating current 0: One bank ACTIVATE-to-PRECHARGE	I _{DD0} ¹	320	304	mA
Operating current 1: One bank ACTIVATE-to-READ-to-PRECHARGE	I _{DD1} ¹	440	424	mA
Precharge power-down current: Slow exit	I _{DD2P0} ²	176	160	mA
Precharge power-down current: Fast exit	I _{DD2P1} ²	176	176	mA
Precharge quiet standby current	I _{DD2Q} ²	240	240	mA
Precharge standby current	I _{DD2N} ²	272	256	mA
Precharge standby ODT current	I _{DD2NT} ¹	264	240	mA
Active power-down current	I _{DD3P} ²	240	240	mA
Active standby current	I _{DD3N} ²	336	320	mA
Burst read operating current	I _{DD4R} ¹	904	800	mA
Burst write operating current	I _{DD4W} ¹	992	888	mA
Refresh current	I _{DD5B} ¹	1304	1296	mA
Self refresh temperature current: MAX T _C = 85°C	I _{DD6} ²	240	240	mA
Self refresh temperature current (SRT-enabled): MAX T _C = 95°C	I _{DD6ET} ²	368	368	mA
All banks interleaved read current	I _{DD7} ¹	1256	1120	mA
Reset current	I _{DD8} ²	208	208	mA

Notes: 1. One module rank in the active IDD; the other rank in I_{DD2P0} (slow exit). 2. All ranks in this IDD condition.



**4GB, 8GB (x64, DR) 240-Pin 1.5V DDR3 UDIMM
Serial Presence-Detect EEPROM**

Table 15: Serial Presence-Detect EEPROM DC Operating Conditions

All voltages referenced to VDDSPD

Parameter/Condition	Symbol	Min	Max	Units
Supply voltage	V_{DDSPD}	3.0	3.6	V
Input low voltage: Logic 0; All inputs	V_{IL}	-0.45	$V_{DDSPD} \times 0.3$	V
Input high voltage: Logic 1; All inputs	V_{IH}	$V_{DDSPD} \times 0.7$	$V_{DDSPD} + 1.0$	V
Output low voltage: IOUT = 3mA	V_{OL}	-	0.4	V
Input leakage current: VIN = GND to VDD	I_{LI}	0.1	2.0	μA
Output leakage current: VOUT = GND to VDD	I_{LO}	0.05	2.0	μA

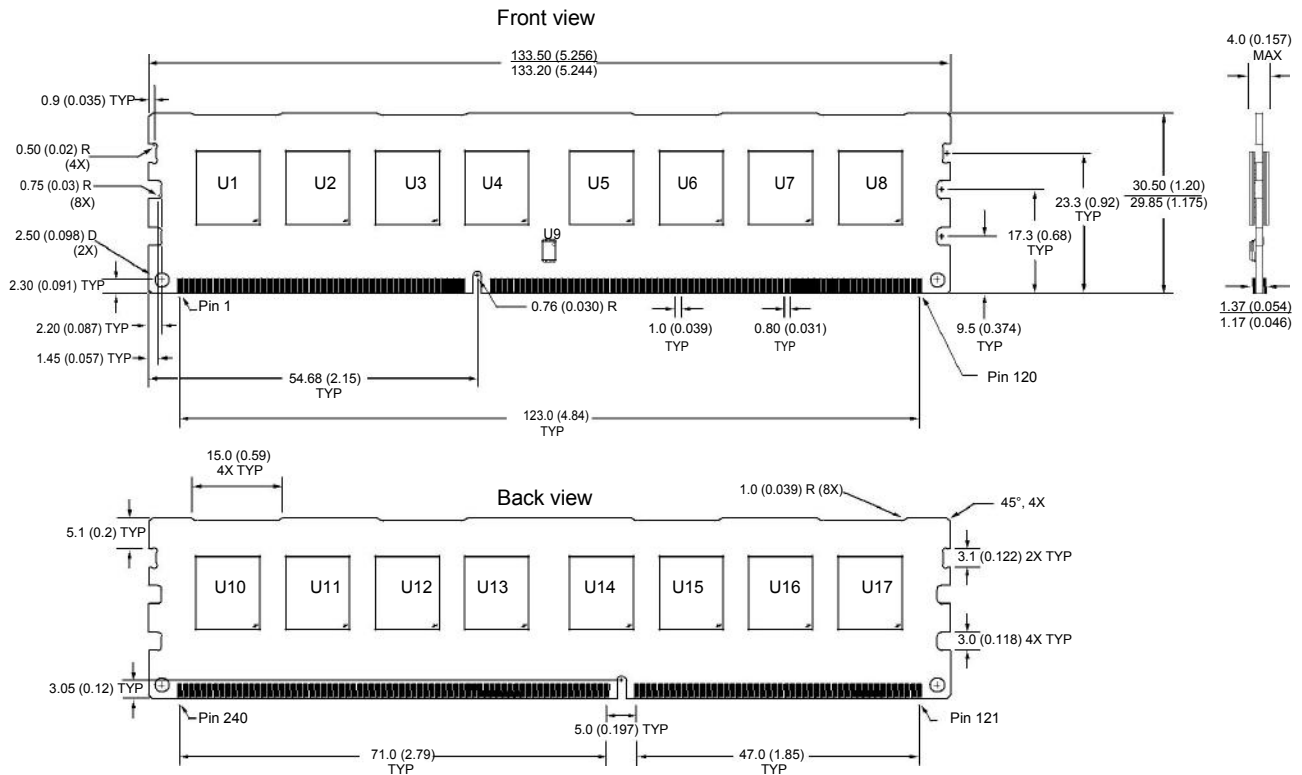
Table 16: Serial Presence-Detect EEPROM AC Operating Conditions

Parameter/Condition	Symbol	Min	Max	Units	Notes
Clock frequency	t_{SCL}	10	400	kHz	
Clock pulse width HIGH time	t_{HIGH}	0.6	-	μs	
Clock pulse width LOW time	t_{LOW}	1.3	-	μs	
SDA rise time	t_R	-	300	μs	1
SDA fall time	t_F	20	300	ns	1
Data-in setup time	$t_{SU:DAT}$	100	-	ns	
Data-in hold time	$t_{HD:DI}$	0	-	μs	
Data-out hold time	$t_{HD:DAT}$	200	900	ns	
Data out access time from SCL LOW	$t_{AA:DAT}$	0.2	0.9	μs	2
Start condition setup time	$t_{SU:STA}$	0.6	-	μs	3
Start condition hold time	$t_{HD:STA}$	0.6	-	μs	
Stop condition setup time	$t_{SU:STO}$	0.6	-	μs	
Time the bus must be free before a new transition can start	t_{BUF}	1.3	-	μs	
WRITE time	t_W	-	10	ms	

- Notes:
1. Guaranteed by design and characterization, not necessarily tested.
 2. To avoid spurious start and stop conditions, a minimum delay is placed between the fall-ing edge of SCL and the falling or rising edge of SDA.
 3. For a restart condition, or following a WRITE cycle.

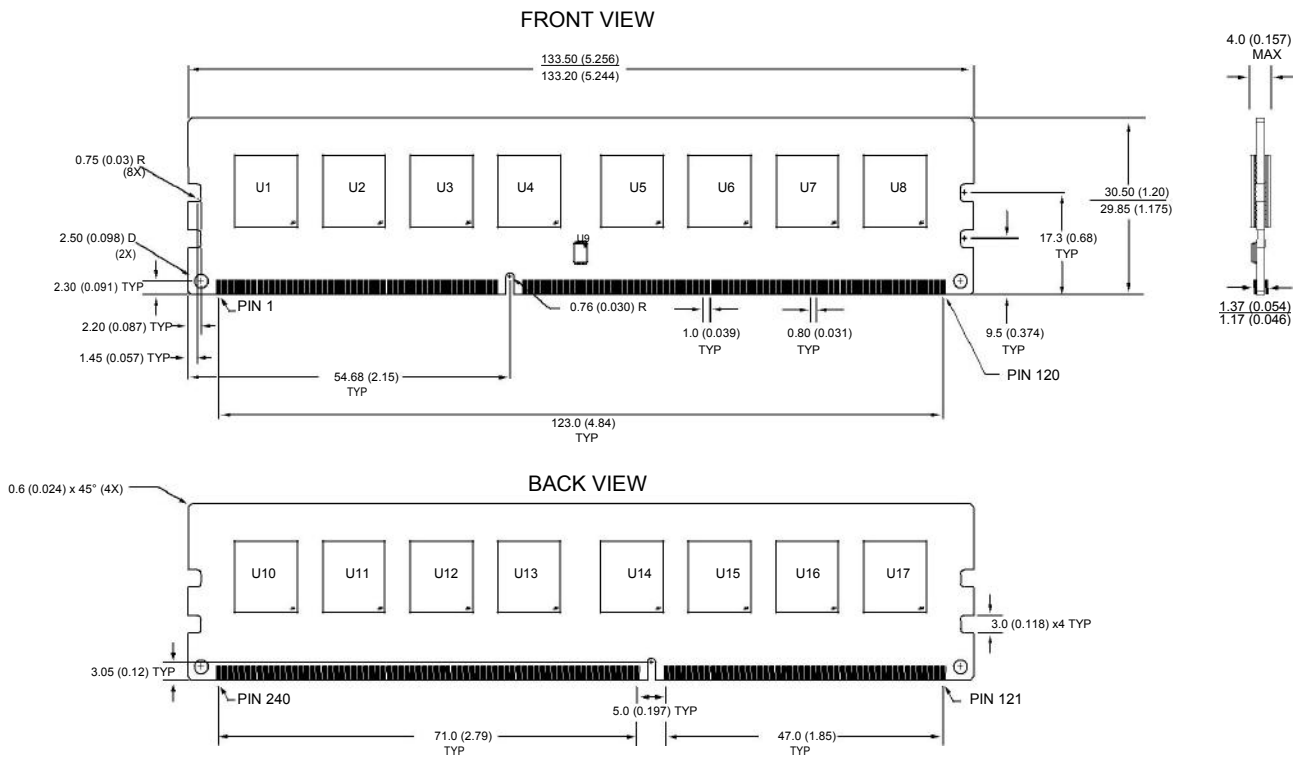
Module Dimensions

Figure 4: 240-Pin DDR3 UDIMM (R/C-B)



- Notes:
1. All dimensions are in millimeters (inches); MAX/MIN or typical (TYP) where noted.
 2. The dimensional diagram is for reference only. Refer to the JEDEC MO document for additional design dimensions.

Figure 5: 240-Pin DDR3 UDIMM (R/C-B1)



- Notes:
1. All dimensions are in millimeters (inches); MAX/MIN or typical (TYP) where noted.
 2. The dimensional diagram is for reference only. Refer to the JEDEC MO document for additional design dimensions.