

# 1.35V DDR3L SDRAM UDIMM

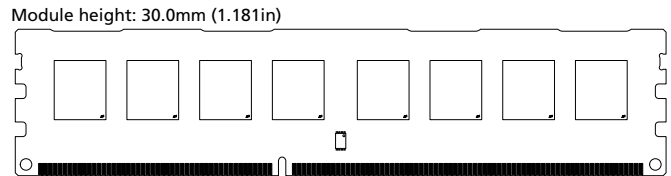
**MT16KTF51264AZ – 4GB**

**MT16KTF1G64AZ – 8GB**

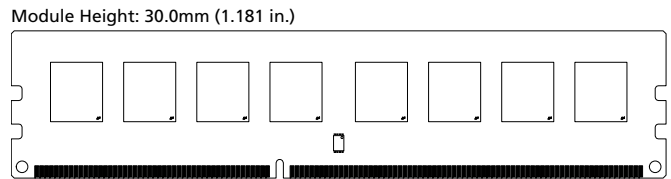
## Features

- DDR3L 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 (512 Meg x 64), 8GB (1 Gig x 64)
- $V_{DD} = V_{DDQ} = 1.35V$  (1.283–1.45V)
- $V_{DD} = V_{DDQ} = 1.5V$  (1.425–1.575V)
- Backward-compatible to  $V_{DD} = V_{DDQ} = 1.5V \pm 0.75V$
- $V_{DDSPD} = 3.0\text{--}3.6V$
- 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

**Table 1: Key Timing Parameters**

Speed Grade	Industry Nomenclature	Data Rate (MT/s)								$t_{RCD}$ (ns)	$t_{RP}$ (ns)	$t_{RC}$ (ns)
		CL = 13	CL = 11	CL = 10	CL = 9	CL = 8	CL = 7	CL = 6	CL = 5			
-1G9	PC3-14900	1866	1600	1333	1333	1066	1066	800	667	13.125	13.125	47.125
-1G6	PC3-12800	–	1600	1333	1333	1066	1066	800	667	13.125	13.125	48.125
-1G4	PC3-10600	–	–	1333	1333	1066	1066	800	667	13.125	13.125	49.125
-1G1	PC3-8500	–	–	–	–	1066	1066	800	667	13.125	13.125	50.625
-1G0	PC3-8500	–	–	–	–	1066	–	800	667	15	15	52.5
-80B	PC3-6400	–	–	–	–	–	–	800	667	15	15	52.5



**Table 2: Addressing**

Parameter	4GB	8GB
Refresh count	8K	8K
Row address	32K A[14:0]	64K A[15:0]
Device bank address	8 BA[2:0]	8 BA[2:0]
Device configuration	2Gb (256 Meg x 8)	4Gb (512 Meg x 8)
Column address	1K A[9:0]	1K A[9:0]
Module rank address	2 S#[1:0]	2 S#[1:0]

**Table 3: Part Numbers and Timing Parameters – 4GB Modules**

Base device: MT41K256M8,<sup>1</sup> 2Gb 1.35V DDR3L SDRAM

Part Number <sup>2</sup>	Module Density	Configuration	Module Bandwidth	Memory Clock/ Data Rate	CL- <sup>t</sup> RCD- <sup>t</sup> RP (Clock Cycles)
MT16KTF51264AZ-1G6__	4GB	512 Meg x 64	12.8 GB/s	1.25ns/1600 MT/s	11-11-11
MT16KTF51264AZ-1G4__	4GB	512 Meg x 64	10.6 GB/s	1.5ns/1333 MT/s	9-9-9

**Table 4: Part Numbers and Timing Parameters – 8GB Modules**

Base device: MT41K512M8,<sup>1</sup> 4Gb 1.35V DDR3L SDRAM

Part Number <sup>2</sup>	Module Density	Configuration	Module Bandwidth	Memory Clock/ Data Rate	CL- <sup>t</sup> RCD- <sup>t</sup> RP (Clock Cycles)
MT16KTF1G64AZ-1G9__	8GB	1 Gig x 64	14.9 GB/s	1.07ns/1866 MT/s	13-13-13
MT16KTF1G64AZ-1G6__	8GB	1 Gig x 64	12.8 GB/s	1.25ns/1600 MT/s	11-11-11

- Notes:
1. Data sheets for the base device parts can be found on Micron’s web site.
  2. All part numbers end with a two-place code (not shown), designating component and PCB revisions. Consult factory for current revision codes. Example: MT16KTF1G64AZ-1G9P1.



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

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	<b>Address inputs:</b> 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	<b>Bank address inputs:</b> 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	<b>Clock:</b> 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	<b>Clock enable:</b> Enables (registered HIGH) and disables (registered LOW) internal circuitry and clocks on the DRAM.
DMx	Input	<b>Data mask (x8 devices only):</b> 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	<b>On-die termination:</b> 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	<b>Parity input:</b> Parity bit for Ax, RAS#, CAS#, and WE#.
RAS#, CAS#, WE#	Input	<b>Command inputs:</b> RAS#, CAS#, and WE# (along with S#) define the command being entered.
RESET#	Input (LVCMOS)	<b>Reset:</b> 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	<b>Chip select:</b> Enables (registered LOW) and disables (registered HIGH) the command decoder.
SAx	Input	<b>Serial address inputs:</b> Used to configure the temperature sensor/SPD EEPROM address range on the I <sup>2</sup> C bus.
SCL	Input	<b>Serial clock for temperature sensor/SPD EEPROM:</b> Used to synchronize communication to and from the temperature sensor/SPD EEPROM on the I <sup>2</sup> C bus.
CBx	I/O	<b>Check bits:</b> Used for system error detection and correction.
DQx	I/O	<b>Data input/output:</b> Bidirectional data bus.
DQSx, DQSx#	I/O	<b>Data strobe:</b> Differential data strobes. Output with read data; edge-aligned with read data; input with write data; center-aligned with write data.

**Table 6: Pin Descriptions (Continued)**

Symbol	Type	Description
SDA	I/O	<b>Serial data:</b> Used to transfer addresses and data into and out of the temperature sensor/SPD EEPROM on the I <sup>2</sup> C bus.
TDQSx, TDQSx#	Output	<b>Redundant data strobe (x8 devices only):</b> 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)	<b>Parity error output:</b> Parity error found on the command and address bus.
EVENT#	Output (open drain)	<b>Temperature event:</b> The EVENT# pin is asserted by the temperature sensor when critical temperature thresholds have been exceeded.
V <sub>DD</sub>	Supply	<b>Power supply:</b> 1.35V (1.283–1.45V) backward-compatible to 1.5V (1.425–1.575V). The component V <sub>DD</sub> and V <sub>DDQ</sub> are connected to the module V <sub>DD</sub> .
V <sub>DDSPD</sub>	Supply	<b>Temperature sensor/SPD EEPROM power supply:</b> 3.0–3.6V.
V <sub>REFCA</sub>	Supply	<b>Reference voltage:</b> Control, command, and address V <sub>DD</sub> /2.
V <sub>REFDQ</sub>	Supply	<b>Reference voltage:</b> DQ, DM V <sub>DD</sub> /2.
V <sub>SS</sub>	Supply	Ground.
V <sub>TT</sub>	Supply	<b>Termination voltage:</b> Used for control, command, and address V <sub>DD</sub> /2.
NC	–	<b>No connect:</b> These pins are not connected on the module.
NF	–	<b>No function:</b> 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

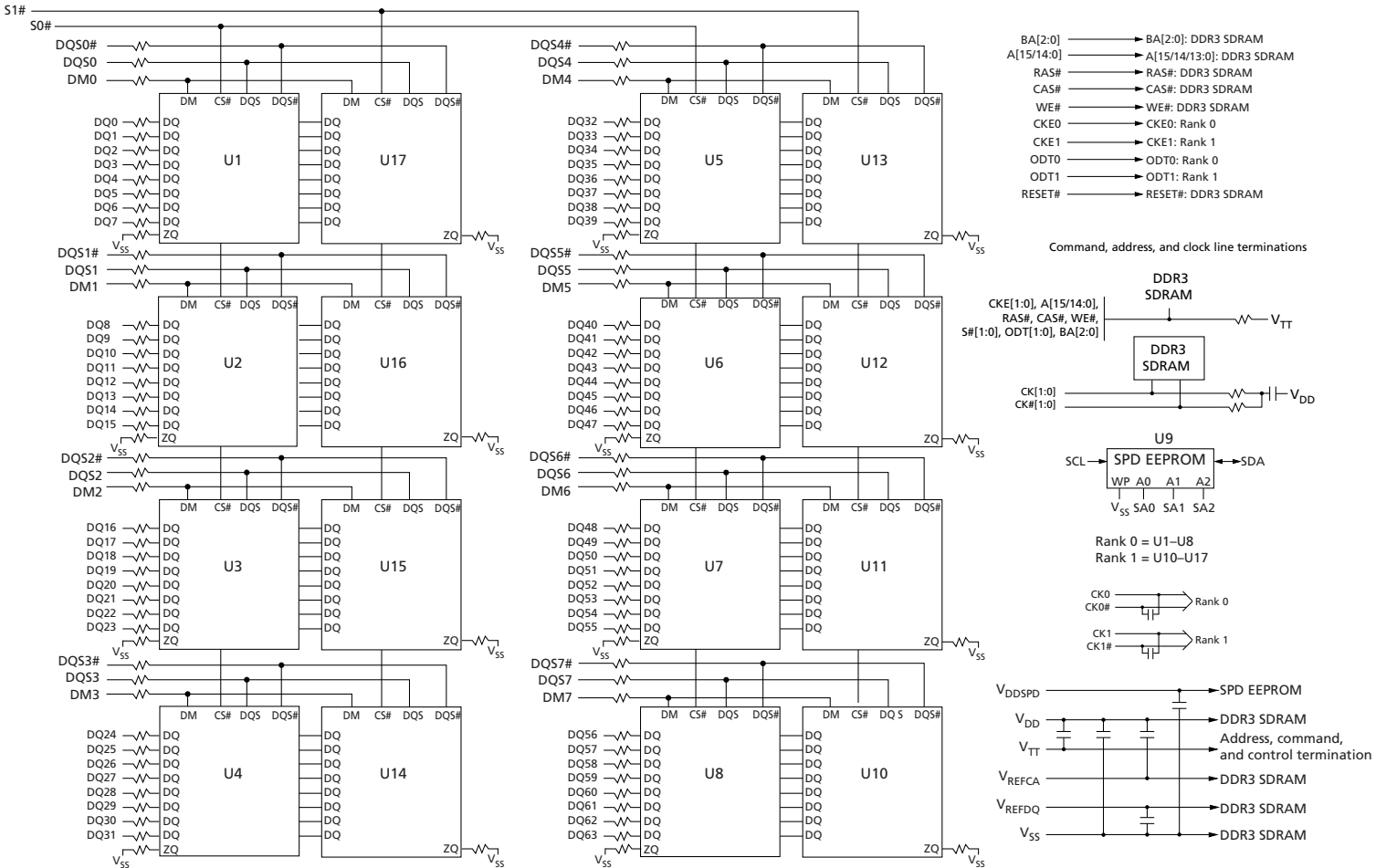


Table 7: Component-to-Module DQ Map (Continued)

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

## 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.

## Serial Presence-Detect EEPROM Operation

DDR3 SDRAM modules incorporate serial presence-detect. The SPD data is stored in a 256-byte EEPROM. The first 128 bytes are programmed by Micron to comply with JEDEC standard JC-45, "Appendix X: Serial Presence Detect (SPD) for DDR3 SDRAM Modules." These bytes identify module-specific timing parameters, configuration information, and physical attributes. The remaining 128 bytes of storage are available for use by the customer. System READ/WRITE operations between the master (system logic) and the slave EEPROM device occur via a standard I<sup>2</sup>C bus using the DIMM's SCL (clock) SDA (data), and SA (address) pins. Write protect (WP) is connected to V<sub>SS</sub>, permanently disabling hardware write protection. For further information refer to Micron technical note TN-04-42, "Memory Module Serial Presence-Detect."

## 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
$V_{DD}$	$V_{DD}$ supply voltage relative to $V_{SS}$	-0.4	1.975	V
$V_{IN}, V_{OUT}$	Voltage on any pin relative to $V_{SS}$	-0.4	1.975	V

**Table 9: Operating Conditions**

Symbol	Parameter	Min	Nom	Max	Units	Notes	
$V_{DD}$	$V_{DD}$ supply voltage	1.283	1.35	1.45	V		
		1.425	1.5	1.575	V	1	
$I_{VTT}$	Termination reference current from $V_{TT}$	-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 $0V \leq V_{IN} \leq V_{DD}$ ; $V_{REF}$ input $0V \leq V_{IN} \leq 0.95V$ (All other pins not under test = $0V$ )	Address inputs RAS#, CAS#, WE#, BA	-32	0	32	$\mu A$	
		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	$\mu A$	
$I_{VREF}$	$V_{REF}$ supply leakage current; $V_{REF} = V_{DD}/2$ or $V_{REFCA} = V_{DD}/2$ (All other pins not under test = $0V$ )		-16	0	16	$\mu A$	
$T_A$	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.  $V_{TT}$  termination voltage in excess of the stated limit will adversely affect the command and address signals' voltage margin and will reduce timing margins.
  3.  $T_A$  and  $T_C$  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  $85^{\circ}C < T_C \leq 95^{\circ}C$ .



## DRAM Operating Conditions

Recommended AC operating conditions are given in the DDR3 component data sheets. Component specifications are available at [micron.com](http://micron.com). Module speed grades correlate with component speed grades, as shown below.

**Table 10: Module and Component Speed Grades**

DDR3 components may exceed the listed module speed grades; module may not be available in all listed speed grades

Module Speed Grade	Component Speed Grade
-2G1	-093
-1G9	-107
-1G6	-125
-1G4	-15E
-1G1	-187E
-1G0	-187
-80C	-25E
-80B	-25

## Design Considerations

### Simulations

Micron memory modules are designed to optimize signal integrity through carefully designed terminations, controlled board impedances, routing topologies, trace length matching, and decoupling. However, good signal integrity starts at the system level. Micron encourages designers to simulate the signal characteristics of the system's memory bus to ensure adequate signal integrity of the entire memory system.

### Power

Operating voltages are specified at the DRAM, not at the edge connector of the module. Designers must account for any system voltage drops at anticipated power levels to ensure the required supply voltage is maintained.

## I<sub>DD</sub> Specifications

**Table 11: DDR3 I<sub>DD</sub> Specifications and Conditions – 4GB (Die Revision K)**

Values are for the MT41K256M8 DDR3L SDRAM only and are computed from values specified in the 1.35V 2Gb (256 Meg x 8) component data sheet

Parameter	Symbol	1600	1333	Units
Operating current 0: One bank ACTIVATE-to-PRECHARGE	I <sub>DD0</sub> <sup>1</sup>	408	400	mA
Operating current 1: One bank ACTIVATE-to-READ-to-PRECHARGE	I <sub>DD1</sub> <sup>1</sup>	512	496	mA
Precharge power-down current: Slow exit	I <sub>DD2P0</sub> <sup>2</sup>	192	192	mA
Precharge power-down current: Fast exit	I <sub>DD2P1</sub> <sup>2</sup>	224	224	mA
Precharge quiet standby current	I <sub>DD2Q</sub> <sup>2</sup>	320	320	mA
Precharge standby current	I <sub>DD2N</sub> <sup>2</sup>	336	336	mA
Precharge standby ODT current	I <sub>DD2NT</sub> <sup>1</sup>	344	328	mA
Active power-down current	I <sub>DD3P</sub> <sup>2</sup>	336	336	mA
Active standby current	I <sub>DD3N</sub> <sup>2</sup>	512	480	mA
Burst read operating current	I <sub>DD4R</sub> <sup>1</sup>	848	752	mA
Burst write operating current	I <sub>DD4W</sub> <sup>1</sup>	872	776	mA
Refresh current	I <sub>DD5B</sub> <sup>1</sup>	1536	1528	mA
Self refresh temperature current: MAX T <sub>C</sub> = 85°C	I <sub>DD6</sub> <sup>2</sup>	192	192	mA
Self refresh temperature current (SRT-enabled): MAX T <sub>C</sub> = 95°C	I <sub>DD6ET</sub> <sup>2</sup>	240	240	mA
All banks interleaved read current	I <sub>DD7</sub> <sup>1</sup>	1344	1296	mA
Reset current	I <sub>DD8</sub> <sup>2</sup>	224	224	mA

- Notes: 1. One module rank in the active I<sub>DD</sub>; the other rank in I<sub>DD2P0</sub> (slow exit).  
2. All ranks in this I<sub>DD</sub> condition.



**Table 12: DDR3 I<sub>DD</sub> Specifications and Conditions – 8GB (Die Revision E)**

Values are for the MT41K512M8 DDR3L SDRAM only and are computed from values specified in the 1.35V 4Gb (512 Meg x 8) component data sheet

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

- Notes: 1. One module rank in the active I<sub>DD</sub>; the other rank in I<sub>DD2P0</sub> (slow exit).  
2. All ranks in this I<sub>DD</sub> condition.

**Table 13: DDR3 I<sub>DD</sub> Specifications and Conditions – 8GB (Die Revision N)**

Values are for the MT41K512M8 DDR3L SDRAM only and are computed from values specified in the 1.35V 4Gb (512 Meg x 8) component data sheet

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

- Notes: 1. One module rank in the active I<sub>DD</sub>; the other rank in I<sub>DD2P0</sub> (slow exit).  
2. All ranks in this I<sub>DD</sub> condition.



**Table 14: DDR3 I<sub>DD</sub> Specifications and Conditions – 8GB (Die Revision P)**

Values are for the MT41K512M8 DDR3L SDRAM only and are computed from values specified in the 1.35V 4Gb (512 Meg x 8) component data sheet

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

- Notes: 1. One module rank in the active I<sub>DD</sub>; the other rank in I<sub>DD2P0</sub> (slow exit).  
2. All ranks in this I<sub>DD</sub> condition.



## Serial Presence-Detect EEPROM

For the latest SPD data, refer to Micron's SPD page: [micron.com/spd](http://micron.com/spd).

**Table 15: Serial Presence-Detect EEPROM DC Operating Conditions**

All voltages referenced to  $V_{DDSPD}$

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: $I_{OUT} = 3\text{mA}$	$V_{OL}$	-	0.4	V
Input leakage current: $V_{IN} = \text{GND to } V_{DD}$	$I_{LI}$	0.1	2.0	$\mu\text{A}$
Output leakage current: $V_{OUT} = \text{GND to } V_{DD}$	$I_{LO}$	0.05	2.0	$\mu\text{A}$

**Table 16: Serial Presence-Detect EEPROM AC Operating Conditions**

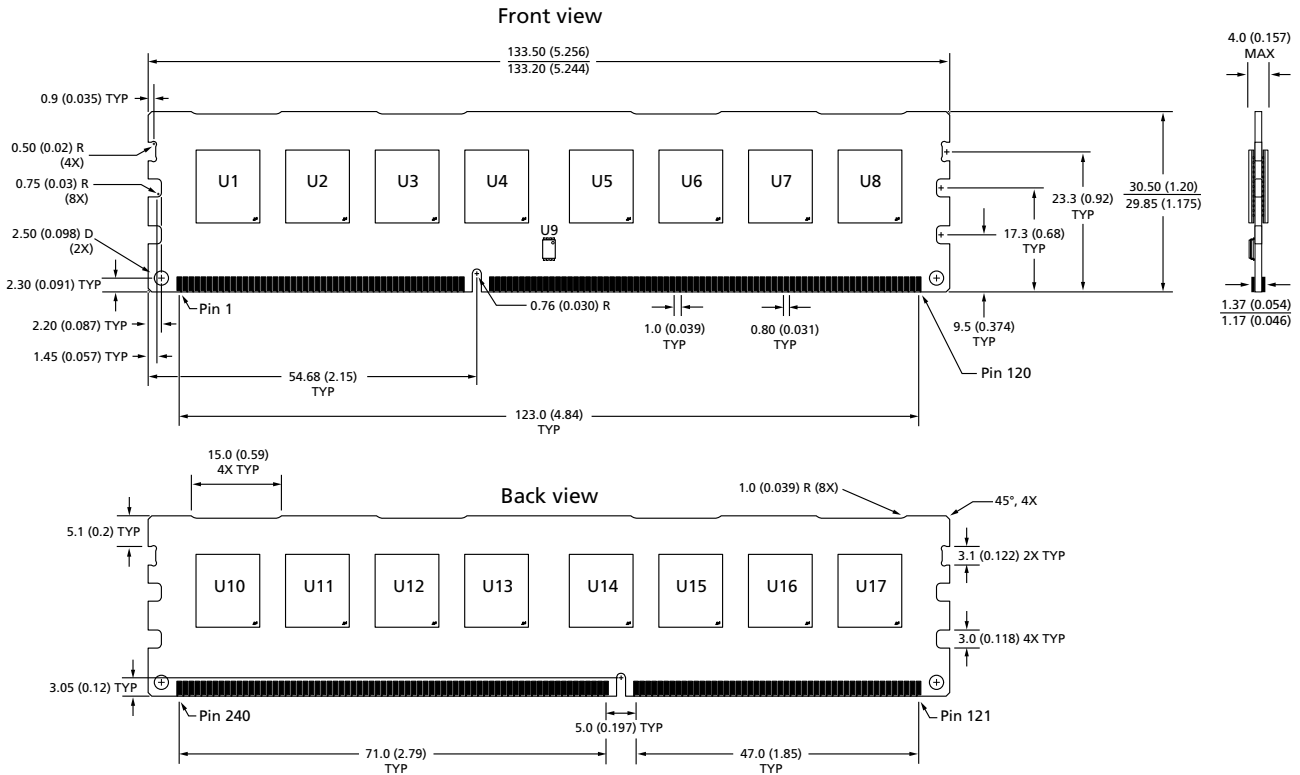
Parameter/Condition	Symbol	Min	Max	Units	Notes
Clock frequency	$t_{SCL}$	10	400	kHz	
Clock pulse width HIGH time	$t_{HIGH}$	0.6	-	$\mu\text{s}$	
Clock pulse width LOW time	$t_{LOW}$	1.3	-	$\mu\text{s}$	
SDA rise time	$t_R$	-	300	$\mu\text{s}$	1
SDA fall time	$t_F$	20	300	ns	1
Data-in setup time	$t_{SU:DAT}$	100	-	ns	
Data-in hold time	$t_{HD:DI}$	0	-	$\mu\text{s}$	
Data-out hold time	$t_{HD:DAT}$	200	900	ns	
Data out access time from SCL LOW	$t_{AA:DAT}$	0.2	0.9	$\mu\text{s}$	2
Start condition setup time	$t_{SU:STA}$	0.6	-	$\mu\text{s}$	3
Start condition hold time	$t_{HD:STA}$	0.6	-	$\mu\text{s}$	
Stop condition setup time	$t_{SU:STO}$	0.6	-	$\mu\text{s}$	
Time the bus must be free before a new transition can start	$t_{BUF}$	1.3	-	$\mu\text{s}$	
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 falling edge of SCL and the falling or rising edge of SDA.
  3. For a restart condition, or following a WRITE cycle.



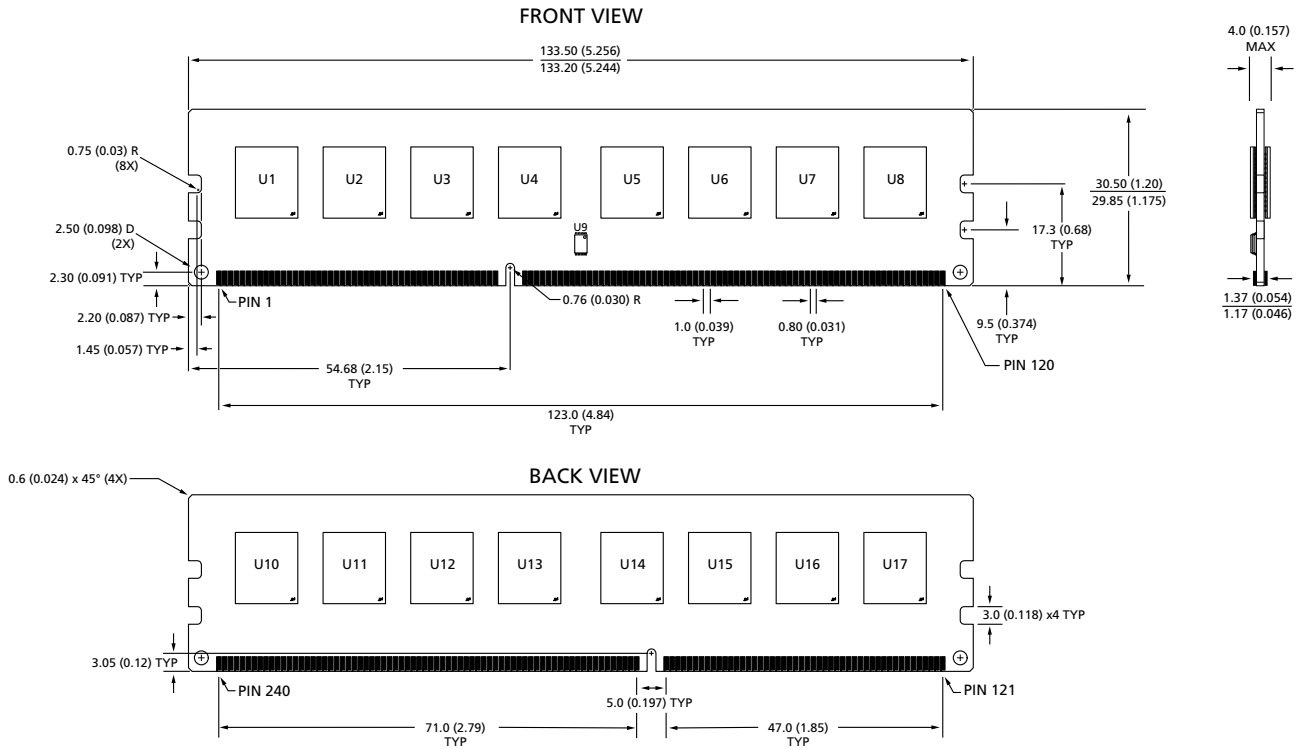
## Module Dimensions

**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.

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This data sheet contains minimum and maximum limits specified over the power supply and temperature range set forth herein. Although considered final, these specifications are subject to change, as further product development and data characterization sometimes occur.