

# DDR3 SDRAM RDIMM

**MT18JS(Z)F25672PZ – 2GB**

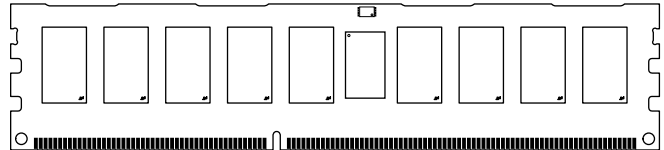
**MT18JS(Z)F51272PZ – 4GB**

## Features

- DDR3 functionality and operations supported as per the component data sheet
- 240-pin, registered dual in-line memory module (RDIMM)
- Fast data transfer rates: PC3-12800, PC3-10600, PC3-8500, or PC3-6400
- 2GB (256 Meg x 72)
- 4GB (512 Meg x 72)
- $V_{DD} = 1.5V \pm 0.075V$
- $V_{DDSPD} = +3.0V$  to  $+3.6V$
- Supports ECC error detection and correction
- Nominal and dynamic on-die termination (ODT) for data and strobe signals
- Single rank
- On-board I<sup>2</sup>C temperature sensor with integrated serial presence-detect (SPD) EEPROM
- 8 internal device banks
- Fixed burst chop (BC) of 4 and burst length (BL) of 8 via the mode register set (MRS)
- Selectable BC4 or BL8 on-the-fly (OTF)
- Gold edge contacts
- Halogen-free
- Fly-by topology
- Terminated control, command, and address bus

**Figure 1: 240-Pin RDIMM (MO-269 R/C C)**

Module height: 30mm (1.18in)



## Options

- Heat spreader
  - Without heat spreader JSF
  - With heat spreader JSZF
- Operating temperature
  - Commercial ( $0^{\circ}C \leq T_A \leq +70^{\circ}C$ ) None
- Package
  - 240-pin DIMM (halogen-free) Z
- Frequency/CAS latency
  - 1.255ns @ CL = 11 (DDR3-1600) -1G6
  - 1.5ns @ CL = 9 (DDR3-1333) -1G4
  - 1.87ns @ CL = 7 (DDR3-1066) -1G1

## Marking

**Table 1: Key Timing Parameters**

Speed Grade	Industry Nomenclature	Data Rate (MT/s)							t <sub>RCD</sub> (ns)	t <sub>RP</sub> (ns)	t <sub>RC</sub> (ns)
		CL = 11	CL = 10	CL = 9	CL = 8	CL = 7	CL = 6	CL = 5			
-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
-80C	PC3-6400	–	–	–	–	–	800	800	12.5	12.5	50
-80B	PC3-6400	–	–	–	–	–	800	667	15	15	52.5

**Table 2: Addressing**

Parameter	2GB	4GB
Refresh count	8K	8K
Row address	16K A[13:0]	32K A[14:0]
Device bank address	8 BA[2:0]	8 BA[2:0]
Device configuration	1Gb (256 Meg x 4)	2Gb (512 Meg x 4)
Column address	2K A[11, 9:0]	1K A[9:0]
Module rank address	1 S0#	1 S0#

**Table 3: Part Numbers and Timing Parameters – 2GB Modules**

Base device: MT41J256M4,<sup>1</sup> 1Gb DDR3 SDRAM

Part Number <sup>2</sup>	Module Density	Configuration	Module Bandwidth	Memory Clock/Data Rate	Clock Cycles (CL- <sup>t</sup> RCD- <sup>t</sup> RP)
MT18JS(Z)F25672PZ-1G6__	2GB	256 Meg x 72	12.8 GB/s	1.25ns/1600 MT/s	11-11-11
MT18JS(Z)F25672PZ-1G4__	2GB	256 Meg x 72	10.6 GB/s	1.5ns/1333 MT/s	9-9-9
MT18JS(Z)F25672PZ-1G1__	2GB	256 Meg x 72	8.5 GB/s	1.87ns/1066 MT/s	7-7-7

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

Base device: MT41J512M4,<sup>1</sup> 2Gb DDR3 SDRAM

Part Number <sup>2</sup>	Module Density	Configuration	Module Bandwidth	Memory Clock/Data Rate	Clock Cycles (CL- <sup>t</sup> RCD- <sup>t</sup> RP)
MT18JS(Z)F51272PZ-1G6__	4GB	512 Meg x 72	12.8 GB/s	1.25ns/1600 MT/s	11-11-11
MT18JS(Z)F51272PZ-1G4__	4GB	512 Meg x 72	10.6 GB/s	1.5ns/1333 MT/s	10-10-10
MT18JS(Z)F51272PZ-1G1__	4GB	512 Meg x 72	8.5 GB/s	1.87ns/1066 MT/s	8-8-8

- Notes:
1. The data sheet for the base device can be found on Micron's Web site.
  2. All part numbers end with a two-place code (not shown) that designates component and PCB revisions. Consult factory for current revision codes. Example: MT18JSF51272PZ-1G1D1.



## Pin Assignments and Descriptions

Table 5: Pin Assignments

240-Pin DDR3 RDIMM Front								240-Pin DDR3 RDIMM 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	DQS12	182	V <sub>DD</sub>	212	DQS14
3	DQ0	33	DQS3#	63	NF	93	DQS5#	123	DQ5	153	DQS12#	183	V <sub>DD</sub>	213	DQS14#
4	DQ1	34	DQS3	64	NF	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	DQS9	155	DQ30	185	CK0#	215	DQ46
6	DQS0#	36	DQ26	66	V <sub>DD</sub>	96	DQ42	126	DQS9#	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	EVENT#	217	V <sub>SS</sub>
8	V <sub>SS</sub>	38	V <sub>SS</sub>	68	Par_In	98	V <sub>SS</sub>	128	DQ6	158	CB4	188	A0	218	DQ52
9	DQ2	39	CB0	69	V <sub>DD</sub>	99	DQ48	129	DQ7	159	CB5	189	V <sub>DD</sub>	219	DQ53
10	DQ3	40	CB1	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	DQS17	191	V <sub>DD</sub>	221	DQS15
12	DQ8	42	DQS8#	72	V <sub>DD</sub>	102	DQS6#	132	DQ13	162	DQS17#	192	RAS#	222	DQS15#
13	DQ9	43	DQS8	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	DQS10	164	CB6	194	V <sub>DD</sub>	224	DQ54
15	DQS1#	45	CB2	75	V <sub>DD</sub>	105	DQ50	135	DQS10#	165	CB7	195	ODT0	225	DQ55
16	DQS1	46	CB3	76	NC	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	NC	107	V <sub>SS</sub>	137	DQ14	167	NC	197	V <sub>DD</sub>	227	DQ60
18	DQ10	48	V <sub>TT</sub>	78	V <sub>DD</sub>	108	DQ56	138	DQ15	168	RESET#	198	NC	228	DQ61
19	DQ11	49	V <sub>TT</sub>	79	NC	109	DQ57	139	V <sub>SS</sub>	169	NC	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	DQS16
21	DQ16	51	V <sub>DD</sub>	81	DQ32	111	DQS7#	141	DQ21	171	A15	201	DQ37	231	DQS16#
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	Err_Out#	83	V <sub>SS</sub>	113	V <sub>SS</sub>	143	DQS11	173	V <sub>DD</sub>	203	DQS13	233	DQ62
24	DQS2#	54	V <sub>DD</sub>	84	DQS4#	114	DQ58	144	DQS11#	174	A12	204	DQS13#	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>

**Table 6: Pin Descriptions**

Symbol	Type	Description
A[15:0]	Input	<b>Address inputs:</b> Provide the row address for ACTIVATE 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 is sampled during a PRECHARGE command to determine whether the PRECHARGE applies to one bank (A10 LOW, bank selected by BA[2:0]) or all banks (A10 HIGH). If only one bank is to be precharged, the bank is selected by BA. A12 is also used for BC4/BL8 identification as “BL on-the-fly” during CAS commands. The address inputs also provide the op-code during the mode register command set. A[13:0] address the 1Gb DDR3 devices. A[14:0] address the 2Gb DDR3 devices. A15 is needed to calculate parity on the command/address bus.
BA[2:0]	Input	<b>Bank address inputs:</b> BA[2:0] define the device bank to which an ACTIVATE, READ, WRITE, or PRECHARGE command is being applied. BA[2:0] define which mode register (MR0, MR1, MR2, and MR3) is loaded during the LOAD MODE command. BA[1:0] are used as part of the parity calculation.
CK0, CK0#	Input	<b>Clock:</b> CK and CK# are 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#.
CKE0	Input	<b>Clock enable:</b> CKE enables (registered HIGH) and disables (registered LOW) internal circuitry and clocks on the DRAM.
ODT0	Input	<b>On-die termination:</b> ODT enables (registered HIGH) and disables (registered LOW) termination resistance internal to the DRAM. When enabled in normal operation, ODT is only applied to the following pins: DQ, DQS, DQS#, and DM. The ODT input will be ignored if disabled via the LOAD MODE command.
Par_In	Input	<b>Parity input:</b> Parity bit for the address, 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 CMOS input referenced to V <sub>SS</sub> . The RESET# input receiver is a CMOS input defined as a rail-to-rail signal with DC HIGH $\geq 0.8 \times V_{DD}$ and DC LOW $\leq 0.2 \times V_{DD}$ .
S0#	Input	<b>Chip select:</b> S# enables (registered LOW) and disables (registered HIGH) the command decoder.
SA[2:0]	Input	<b>Serial address inputs:</b> These pins are 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> SCL is used to synchronize communication to and from the temperature sensor/SPD EEPROM.
CB[7:0]	I/O	<b>Check bits:</b> Data used for ECC.
DQ[63:0]	I/O	<b>Data input/output:</b> Bidirectional data bus.
DQS[17:0], DQS#[17:0]	I/O	<b>Data strobe:</b> DQS and DQS# are differential data strobes. Output with read data. Edge-aligned with read data. Input with write data. Center-aligned with write data.
SDA	I/O	<b>Serial data:</b> SDA is a bidirectional pin used to transfer addresses and data into and out of the temperature sensor/SPD EEPROM on the I <sup>2</sup> C bus.
Err_Out#	Output (open drain)	<b>Parity error output:</b> Parity error found on the command and address bus.

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

Symbol	Type	Description
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> 1.5V ±0.075V. 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> +3.0V to +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).
NF	–	<b>No function:</b> Connected within the module, but provides no functionality.
NC	–	<b>No connect:</b> These pins are not connected on the module.

## 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	1	4		1	9	13
	2	3	10		2	11	19
	3	0	3		3	8	12
U3	0	18	27	U4	0	26	36
	1	17	22		1	25	31
	2	19	28		2	27	37
	3	16	21		3	24	30
U5	0	CB2	45	U8	0	34	87
	1	CB1	40		1	33	82
	2	CB3	46		2	35	88
	3	CB0	39		3	32	81
U9	0	42	96	U10	0	50	105
	1	41	91		1	49	100
	2	43	97		2	51	106
	3	40	90		3	48	99
U11	0	58	114	U12	0	60	227
	1	57	109		1	62	233
	2	59	115		2	61	228
	3	56	108		3	63	234
U13	0	52	218	U14	0	44	209
	1	54	224		1	46	215
	2	53	219		2	45	210
	3	55	225		3	47	216
U15	0	36	200	U16	0	CB4	158
	1	38	206		1	CB6	164
	2	37	201		2	CB5	159
	3	39	207		3	CB7	165
U17	0	28	149	U18	0	20	140
	1	30	155		1	22	146
	2	29	150		2	21	141
	3	31	156		3	23	147
U19	0	12	131	U20	0	4	122
	1	14	137		1	6	128
	2	13	132		2	5	123

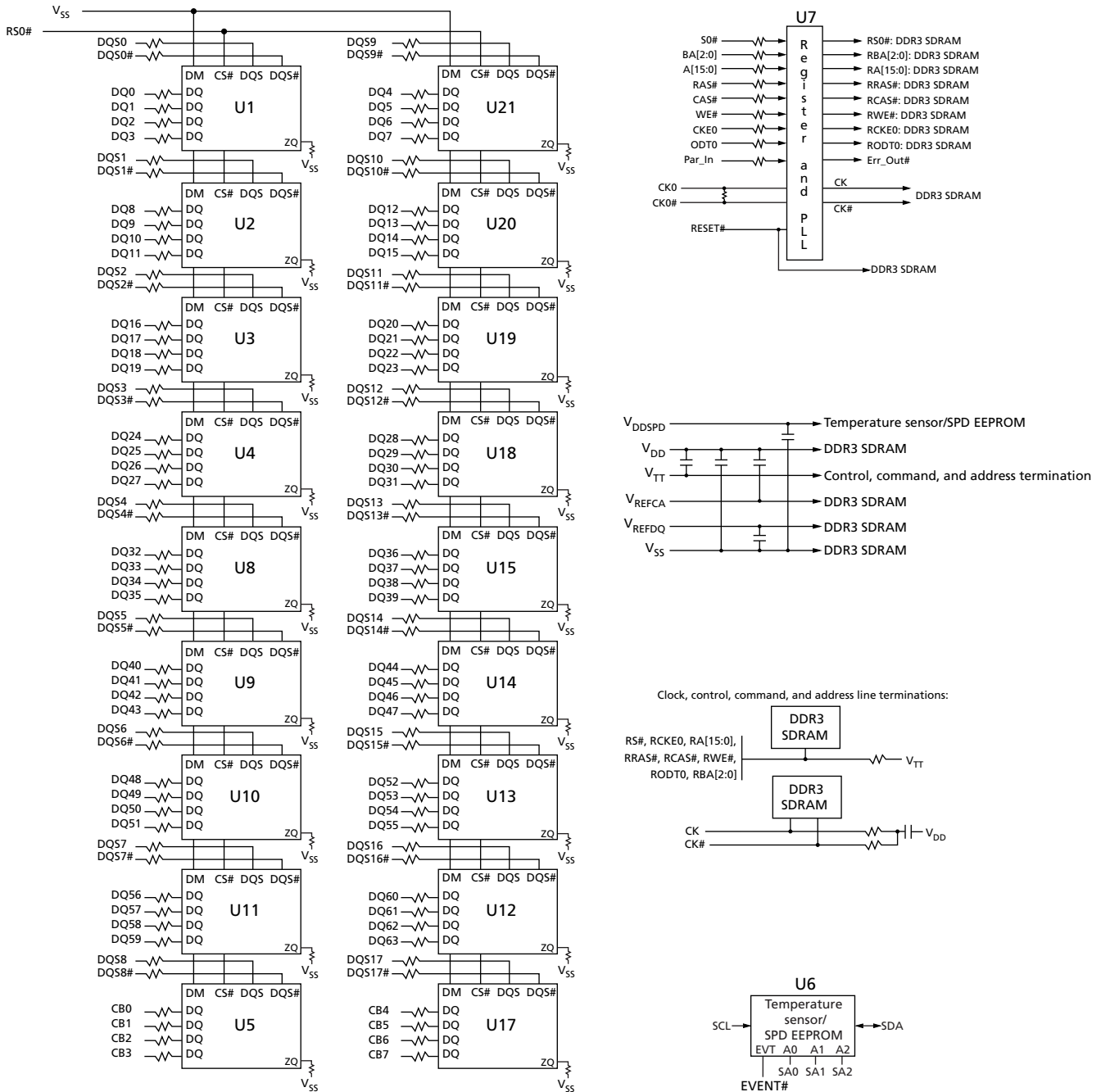


Table 7: Component-to-Module DQ Map (Continued)

Component Reference Number	Component DQ	Module DQ	Module Pin Number	Component Reference Number	Component DQ	Module DQ	Module Pin Number
	3	15	138		3	7	129

## Functional Block Diagram

Figure 2: Functional Block Diagram



Note: 1. The ZQ ball on each DDR3 component is connected to an external  $240\Omega \pm 1\%$  resistor that is tied to ground. It is used for the calibration of the component's ODT 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.

## Registering Clock Driver Operation

Registered DDR3 SDRAM modules use a registering clock driver device consisting of a register and a phase-lock loop (PLL). The device complies with the JEDEC standard "Definition of the SSTE32882 Registering Clock Driver with Parity and Quad Chip Selects for DDR3 RDIMM Applications."

The register section of the registering clock driver latches command and address input signals on the rising clock edge. The PLL section of the registering clock driver receives and redrives the differential clock signals (CK, CK#) to the DDR3 SDRAM devices. The register(s) and PLL reduce clock, control, command, and address signals loading by isolating DRAM from the system controller.

## Parity Operations

The registering clock driver includes an even parity function for checking parity. The memory controller accepts a parity bit at the Par\_In input and compares it with the data received on A[15:0], BA[2:0], RAS#, CAS#, and WE#. Valid parity is defined as an even number of ones (1s) across the address and command inputs (A[15:0], BA[2:0], RAS#, CAS#, and WE#) combined with Par\_In. Parity errors are flagged on Err\_Out#.

Address and command parity is checked during all DRAM operations and during control word WRITE operations to the registering clock driver. For SDRAM operations, the address is still propagated to the SDRAM even when there is a parity error. When writing to the internal control words of the registering clock driver, the write will be ignored if parity is not valid. For this reason, systems must connect the Par\_In pins on the DIMM and provide correct parity when writing to the registering clock driver control word configuration registers.

## **Temperature Sensor with Serial Presence-Detect EEPROM**

### **Thermal Sensor Operations**

The temperature from the integrated thermal sensor is monitored and converts into a digital word via the I<sup>2</sup>C bus. System designers can use the user-programmable registers to create a custom temperature-sensing solution based on system requirements. Programming and configuration details comply with JEDEC standard No. 21-C page 4.7-1, "Definition of the TSE2002av, Serial Presence Detect with Temperature Sensor."

### **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. User-specific information can be written into the remaining 128 bytes of storage. READ/WRITE operations between the system (master) and the EEPROM (slave) device occur via an I<sup>2</sup>C bus. Write protect (WP) is connected to Vss, permanently disabling hardware write protect. For further information please 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	1.425	1.5	1.575	V		
$I_{VTT}$	Termination reference current from $V_{TT}$	-600	-	+600	mA		
$V_{TT}$	Termination reference voltage (DC) – command/address bus	$0.49 \times V_{DD} - 20\text{mV}$	$0.5 \times V_{DD}$	$0.51 \times V_{DD} + 20\text{mV}$	V	1	
$I_I$	Input leakage current; Any input $0\text{V} \leq V_{IN} \leq V_{DD}$ ; $V_{REF}$ input $0\text{V} \leq V_{IN} \leq 0.95\text{V}$ (All other pins not under test = 0V)	TBD	TBD	TBD	$\mu\text{A}$		
$I_{OZ}$	Output leakage current; $0\text{V} \leq V_{OUT} \leq V_{DD}$ ; DQ and ODT are disabled; ODT is HIGH	-5	0	+5	$\mu\text{A}$		
$I_{VREF}$	$V_{REF}$ supply leakage current; $V_{REFDQ} = V_{DD}/2$ or $V_{REFCA} = V_{DD}/2$ (All other pins not under test = 0V)	-18	0	+18	$\mu\text{A}$		
$T_A$	Module ambient operating temperature	Commercial	0	-	+70	$^{\circ}\text{C}$	2, 3
$T_C$	DDR3 SDRAM component case operating temperature	Commercial	0	-	+95	$^{\circ}\text{C}$	2, 3, 4

- Notes:
- $V_{TT}$  termination voltage in excess of the stated limit will adversely affect the command and address signals' voltage margin and will reduce timing margins.
  - $T_A$  and  $T_C$  are simultaneous requirements.
  - For further information, refer to technical note TN-00-08: "Thermal Applications," available on Micron's Web site.
  - The refresh rate is required to double when  $85^{\circ}\text{C} < T_C \leq 95^{\circ}\text{C}$ .

## DRAM Operating Conditions

Recommended AC operating conditions are given in the DDR3 component data sheets. Component specifications are available on Micron's Web site. 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
-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 – 2GB**

Values are for the MT41J256M4 DDR3 SDRAM only and are computed from values specified in the 1Gb (256 Meg x 4) component data sheet

Parameter	Symbol	1600	1333	1066	Units
Operating current 0: One bank ACTIVATE-to-PRE-CHARGE	I <sub>DD0</sub>	1710	1530	1350	mA
Operating current 1: One bank ACTIVATE-to-READ-to-PRECHARGE	I <sub>DD1</sub>	2070	1890	1710	mA
Precharge power-down current: Slow exit	I <sub>DD2P0</sub>	216	216	216	mA
Precharge power-down current: Fast exit	I <sub>DD2P1</sub>	810	720	630	mA
Precharge quiet standby current	I <sub>DD2Q</sub>	1206	1080	954	mA
Precharge standby current	I <sub>DD2N</sub>	1260	1170	990	mA
Precharge standby ODT current	I <sub>DD2NT</sub>	1710	1530	1350	mA
Active power-down current	I <sub>DD3P</sub>	810	720	630	mA
Active standby current	I <sub>DD3N</sub>	1206	1116	1026	mA
Burst read operating current	I <sub>DD4R</sub>	4500	3600	2880	mA
Burst write operating current	I <sub>DD4W</sub>	4500	3960	3420	mA
Refresh current	I <sub>DD5B</sub>	4680	4320	3960	mA
Self refresh temperature current: MAX T <sub>C</sub> = 85°C	I <sub>DD6</sub>	108	108	108	mA
Self refresh temperature current (SRT-enabled): MAX T <sub>C</sub> = 95°C	I <sub>DD6ET</sub>	162	162	162	mA
All banks interleaved read current	I <sub>DD7</sub>	7200	5670	4500	mA
Reset current	I <sub>DD8</sub>	252	252	252	mA

**Table 12: DDR3 I<sub>DD</sub> Specifications and Conditions – 4GB**

Values are for the MT41J512M4 DDR3 SDRAM only and are computed from values specified in the 1Gb (256 Meg x 4) component data sheet

Parameter	Symbol	1600	1333	1066	Units
Operating current 0: One bank ACTIVATE-to-PRE-CHARGE	I <sub>DD0</sub>	TBD	1440	1260	mA
Operating current 1: One bank ACTIVATE-to-READ-to-PRECHARGE	I <sub>DD1</sub>	TBD	1890	1620	mA
Precharge power-down current: Slow exit	I <sub>DD2P0</sub>	TBD	206	216	mA
Precharge power-down current: Fast exit	I <sub>DD2P1</sub>	TBD	630	540	mA
Precharge quiet standby current	I <sub>DD2Q</sub>	TBD	1170	990	mA
Precharge standby current	I <sub>DD2N</sub>	TBD	1170	990	mA
Precharge standby ODT current	I <sub>DD2NT</sub>	TBD	1530	1350	mA
Active power-down current	I <sub>DD3P</sub>	TBD	810	720	mA
Active standby current	I <sub>DD3N</sub>	TBD	1350	1080	mA
Burst read operating current	I <sub>DD4R</sub>	TBD	3420	2700	mA
Burst write operating current	I <sub>DD4W</sub>	TBD	4050	3330	mA
Refresh current	I <sub>DD5B</sub>	TBD	4590	4410	mA
Self refresh temperature current: MAX T <sub>C</sub> = 85°C	I <sub>DD6</sub>	TBD	162	162	mA
Self refresh temperature current (SRT-enabled): MAX T <sub>C</sub> = 95°C	I <sub>DD6ET</sub>	TBD	216	216	mA
All banks interleaved read current	I <sub>DD7</sub>	TBD	6300	6570	mA
Reset current	I <sub>DD8</sub>	TBD	252	252	mA

## Registering Clock Driver Specifications

**Table 13: Registering Clock Driver Electrical Characteristics**

SSTE32882 devices or equivalent

Symbol	Parameter	Pins	Min	Nom	Max	Units
$V_{DD}$	DC supply voltage	–	1.425	1.5	1.575	V
$V_{REF}$	DC reference voltage	–	$0.49 \times V_{DD} - 20\text{mV}$	$0.5 \times V_{DD}$	$0.51 \times V_{DD} + 20\text{mV}$	V
$V_{TT}$	DC termination voltage	–	$0.49 \times V_{DD} - 20\text{mV}$	$0.5 \times V_{DD}$	$0.51 \times V_{DD} + 20\text{mV}$	V
$V_{IH(AC)}$	AC high-level input voltage	Control, command, address	$V_{REF} + 175\text{mV}$	–	$V_{DD} + 400\text{mV}$	V
$V_{IL(AC)}$	AC low-level input voltage	Control, command, address	–0.4	–	$V_{REF} - 175\text{mV}$	V
$V_{IH(DC)}$	DC high-level input voltage	Control, command, address	$V_{REF} + 100\text{mV}$	–	$V_{DD} + 0.4$	V
$V_{IL(DC)}$	DC low-level input voltage	Control, command, address	–0.4	–	$V_{REF} - 100\text{mV}$	V
$V_{IH(CMOS)}$	High-level input voltage	RESET#, MIRROR	$0.65 \times V_{DD}$	–	$V_{DD}$	V
$V_{IL(CMOS)}$	Low-level input voltage	RESET#, MIRROR	0	–	$0.35 \times V_{DD}$	V
$V_{IX(AC)}$	Differential input cross point voltage range	CK, CK#, FBIN, FBIN#	$0.5 \times V_{DD} - 175\text{mV}$	$0.5 \times V_{DD}$	$0.5 \times V_{DD} + 175\text{mV}$	V
$V_{ID(AC)}$	Differential input voltage	CK, CK#	350	–	$V_{DD} + \text{TBD}$	mV
$I_{OH}$	High-level output current	Err_Out#	–	–	TBD	mA
$I_{OL}$	Low-level output current	Err_Out#	TBD	–	TBD	mA

Note: 1. Timing and switching specifications for the register listed are critical for proper operation of the DDR3 SDRAM RDIMMs. These are meant to be a subset of the parameters for the specific device used on the module.

## Temperature Sensor with Serial Presence-Detect EEPROM

The temperature sensor continuously monitors the module's temperature and can be read back at any time over the I<sup>2</sup>C bus shared with the SPD EEPROM.

**Table 14: Temperature Sensor with Serial Presence-Detect EEPROM Operating Conditions**

Parameter/Condition	Symbol	Min	Max	Units
Supply voltage	V <sub>DDSPD</sub>	+3.0	+3.6	V
Supply current: V <sub>DD</sub> = 3.3V	I <sub>DD</sub>	–	+2.0	mA
Input high voltage: Logic 1; SCL, SDA	V <sub>IH</sub>	+1.45	V <sub>DDSPD</sub> + 1	V
Input low voltage: Logic 0; SCL, SDA	V <sub>IL</sub>	–	+0.55	V
Output low voltage: I <sub>OUT</sub> = 2.1mA	V <sub>OL</sub>	–	+0.4	V
Input current	I <sub>IN</sub>	–5.0	+5.0	μA
Temperature sensing range	–	–40	+125	°C
Temperature sensor accuracy (class B)	–	–1.0	+1.0	°C

**Table 15: Sensor and EEPROM Serial Interface Timing**

Parameter/Condition	Symbol	Min	Max	Units
Time bus must be free before a new transition can start	t <sub>BUF</sub>	4.7	–	μs
SDA fall time	t <sub>F</sub>	20	300	ns
SDA rise time	t <sub>R</sub>	–	1,000	ns
Data hold time	t <sub>HD:DAT</sub>	200	900	ns
Start condition hold time	t <sub>H:STA</sub>	4.0	–	μs
Clock HIGH period	t <sub>HIGH</sub>	4.0	50	μs
Clock LOW period	t <sub>LOW</sub>	4.7	–	μs
SCL clock frequency	t <sub>SCL</sub>	10	100	kHz
Data setup time	t <sub>SU:DAT</sub>	250	–	ns
Start condition setup time	t <sub>SU:STA</sub>	4.7	–	μs
Stop condition setup time	t <sub>SU:STO</sub>	4.0	–	μs

### EVENT# Pin

The temperature sensor also adds the EVENT# pin (open drain). Not used by the SPD EEPROM, EVENT# is a temperature sensor output used to flag critical events that can be set up in the sensor's configuration register.

EVENT# has three defined modes of operation: interrupt mode, compare mode, and critical temperature mode. The open-drain output of EVENT# under the three separate operating modes is illustrated below. Event thresholds are programmed in the 0x01 register using a hysteresis. The alarm window provides a comparison window, with upper and lower limits set in the alarm upper boundary register and the alarm lower boundary register, respectively. When the alarm window is enabled, EVENT# will trigger whenever the temperature is outside the MIN or MAX values set by the user.



The interrupt mode enables software to reset EVENT# after a critical temperature threshold has been detected. Threshold points are set in the configuration register by the user. This mode triggers the critical temperature limit and both the MIN and MAX of the temperature window.

The compare mode is similar to the interrupt mode, except EVENT# cannot be reset by the user and only returns to the logic HIGH state when the temperature falls below the programmed thresholds.

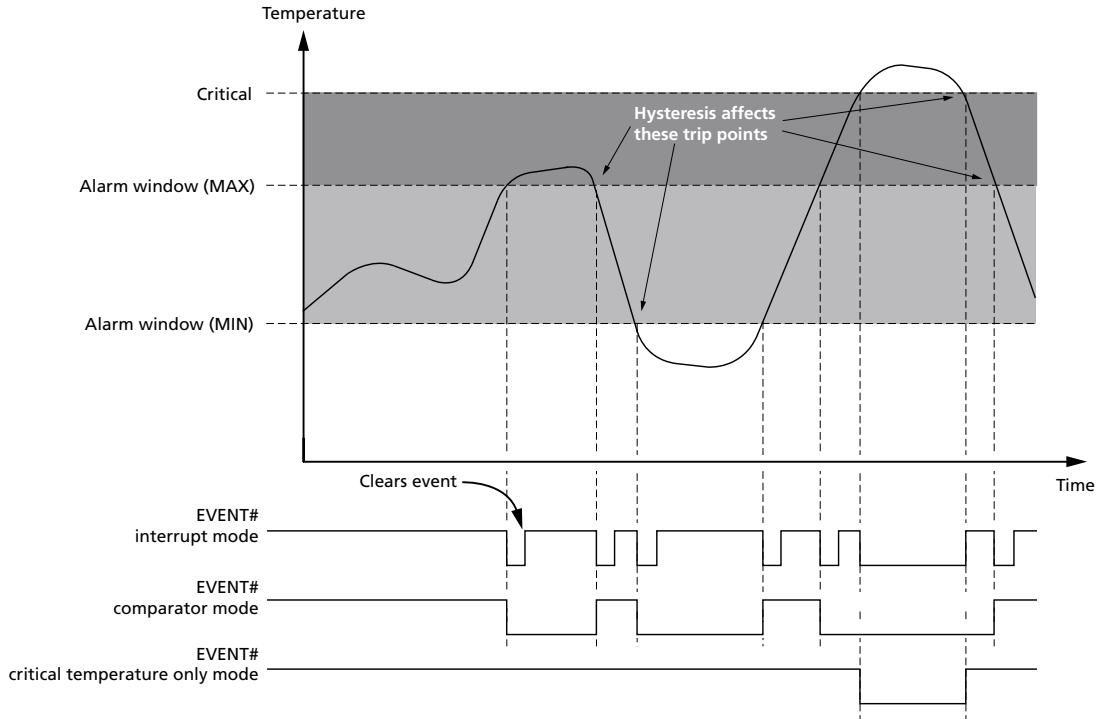
Critical temperature mode triggers EVENT# only when the temperature has exceeded the programmed critical trip point. When the critical trip point has been reached, the temperature sensor goes into comparator mode, and the critical EVENT# cannot be cleared through software.

### SM Bus Slave Subaddress Decoding

The temperature sensor's physical address differs from the SPD EEPROM's physical address: binary 0011 for A0, A1, A2, and RW#, where A2, A1, and A0 are the three slave subaddress pins and the RW# bit is the READ/WRITE flag.

If the slave base address is fixed for the temperature sensor/SPD EEPROM, then the pins set the subaddress bits of the slave address, enabling the devices to be located anywhere within the eight slave address locations. For example, they could be set from 30h to 3Eh.

**Figure 3: EVENT# Pin Functionality**



**Table 16: Temperature Sensor Registers**

Name	Address	Power-on Default
Pointer register	Not applicable	Undefined
Capability register	0x00	0x0001
Configuration register	0x01	0x0000
Alarm temperature upper boundary register	0x02	0x0000
Alarm temperature lower boundary register	0x03	0x0000
Critical temperature register	0x04	0x0000
Temperature register	0x05	Undefined

### Pointer Register

The pointer register selects which of the 16-bit registers is being accessed in subsequent READ and WRITE operations. This register is a write-only register.

**Table 17: Pointer Register Bits 0–7**

Bit							
7	6	5	4	3	2	1	0
0	0	0	0	Register select	Register select	Register select	Register select

**Table 18: Pointer Register Bits 0–2 Descriptions**

Bit			Register
2	1	0	
0	0	0	Capability register
0	0	1	Configuration register
0	1	0	Alarm temperature upper boundary register
0	1	1	Alarm temperature lower boundary register
1	0	0	Critical temperature register
1	0	1	Temperature register

## Capability Register

The capability register indicates the features and functionality supported by the temperature sensor. This register is a read-only register.

**Table 19: Capability Register (Address: 0x00)**

Bit							
15	14	13	12	11	10	9	8
RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
Bit							
7	6	5	4	3	2	1	0
RFU	RFU	RFU	Temperature resolution		Wider range	Precision	Has alarm and critical temperature

**Table 20: Capability Register Bit Description**

Bit	Description
0	Basic capability 1: Has alarm and critical trip point capabilities
1	Accuracy 0: $\pm 2^{\circ}\text{C}$ over the active range and $\pm 3^{\circ}\text{C}$ over the monitor range 1: $\pm 1^{\circ}\text{C}$ over the active range and $\pm 2^{\circ}\text{C}$ over the monitor range
2	Wider range 0: Temperatures lower than $0^{\circ}\text{C}$ are clamped to a binary value of 0 1: Temperatures below $0^{\circ}\text{C}$ can be read

**Table 20: Capability Register Bit Description (Continued)**

Bit	Description
4:3	Temperature resolution 00: 0.5°C LSB 01: 0.25°C LSB 10: 0.125°C LSB 11: 0.0625°C LSB
15:5	0: Must be set to zero

## Configuration Register

**Table 21: Configuration Register (Address: 0x01)**

Bit							
15	14	13	12	11	10	9	8
RFU	RFU	RFU	RFU	RFU	Hysteresis		Shutdown mode
Bit							
7	6	5	4	3	2	1	0
Critical lock bit	Alarm lock bit	Clear event	Event output status	Event output control	Critical event only	Event polarity	Event mode

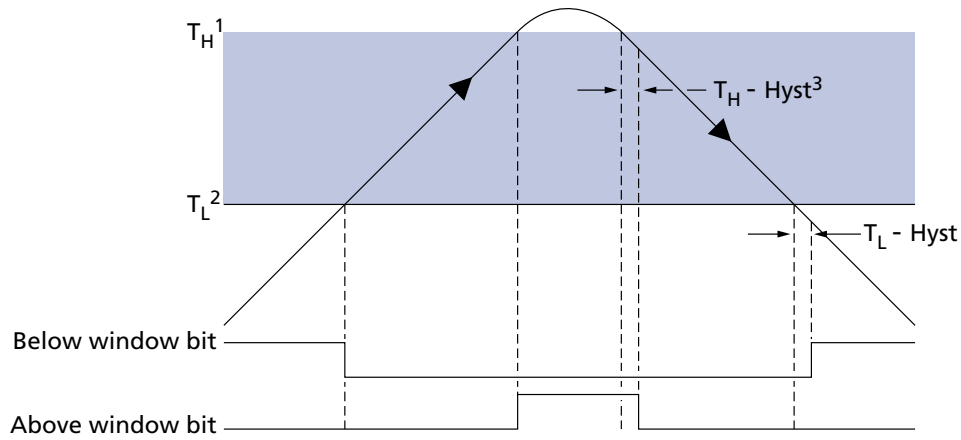
**Table 22: Configuration Register Bit Descriptions**

Bit	Description	Notes
0	Event mode 0: Comparator mode 1: Interrupt mode	Event mode cannot be changed if either of the lock bits is set.
1	EVENT# polarity 0: Active LOW 1: Active HIGH	EVENT# polarity cannot be changed if either of the lock bits is set.
2	Critical event only 0: EVENT# trips on alarm or critical temperature event 1: EVENT# trips only if critical temperature is reached	
3	Event output control 0: Event output disabled 1: Event output enabled	
4	Event status 0: EVENT# has not been asserted by this device 1: EVENT# is being asserted due to an alarm window or critical temperature condition	This is a read-only field in the register. The event causing the event can be determined from the read temperature register.
5	Clear event 0: No effect 1: Clears the event when the temperature sensor is in the interrupt mode	

**Table 22: Configuration Register Bit Descriptions (Continued)**

Bit	Description	Notes
6	Alarm window lock bit 0: Alarm trips are not locked and can be changed 1: Alarm trips are locked and cannot be changed	
7	Critical trip lock bit 0: Critical trip is not locked and can be changed 1: Critical trip is locked and cannot be changed	
8	Shutdown mode 0: Enabled 1: Shutdown	The shutdown mode is a power-saving mode that disables the temperature sensor.
10:9	Hysteresis enable 00: Disable 01: Enable at 1.5°C 10: Enable at 3°C 11: Enable at 6°C	When enabled, a hysteresis is applied to temperature movement around the trip points (see Figure 4 (page 22)). As an example, if the hysteresis register is enabled to a delta of 6°C, the preset trip points will toggle when the temperature reaches the programmed value. These values will reset when the temperature drops below the trip points minus the set hysteresis level. In this case, this would be critical temperature minus 6°C.  The hysteresis is applied to both the above alarm window and the below alarm window bits found in the read-only temperature register (see Table 23 (page 22)). EVENT# is also affected by this register.

**Figure 4: Hysteresis Applied to Temperature Around Trip Points**



- Notes:
1.  $T_H$  is the value set in the alarm temperature upper boundary trip register.
  2.  $T_L$  is the value set in the alarm temperature lower boundary trip register.
  3. Hyst is the value set in the hysteresis bits of the configuration register.

**Table 23: Hysteresis Applied to Alarm Window Bits in the Temperature Register**

Condition	Below Alarm Window Bit		Above Alarm Window Bit	
	Temperature Gradient	Critical Temperature	Temperature Gradient	Critical Temperature
Sets	Falling	$T_L - \text{Hyst}$	Rising	$T_H$
Clears	Rising	$T_L$	Falling	$T_H - \text{Hyst}$

### Temperature Format

The temperature trip point registers and temperature readout register use a 2's complement format to enable negative numbers. The least significant bit (LSB) is equal to 0.0625°C or 0.25°C, depending on which register is referenced. For example, assuming an LSB of 0.0625°C:

- A value of 0x018C would equal 24.75°C
- A value of 0x06C0 would equal 108°C
- A value of 0x1E74 would equal -24.75°C

## Temperature Trip Point Registers

The upper and lower temperature boundary registers are used to set the maximum and minimum values of the alarm window. LSB for these registers is 0.25°C. All RFU bits in the register will always report zero.

**Table 24: Alarm Temperature Lower Boundary Register (Address: 0x02)**

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	MSB										LSB	RFU	RFU
Alarm window upper boundary temperature															

**Table 25: Alarm Temperature Lower Boundary Register (Address: 0x03)**

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	MSB										LSB	RFU	RFU
Alarm window lower boundary temperature															

## Critical Temperature Register

The critical temperature register is used to set the maximum temperature above the alarm window. The LSB for this register is 0.25°C. All RFU bits in the register will always report zero.

**Table 26: Critical Temperature Register (Address: 0x04)**

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	MSB										LSB	RFU	RFU
Critical temperature trip point															

## Temperature Register

The temperature register is a read-only register that provides the current temperature detected by the temperature sensor. The LSB for this register is 0.0625°C with a resolution of 0.0625°C. The most significant bit (MSB) is 128°C in the readout section of this register.

The upper three bits of the register are used to monitor the trip points that are set in the previous three registers.



**Table 27: Temperature Register (Address: 0x05)**

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Above critical trip	Above alarm window	Below alarm window	MSB	Temperature											LSB

**Table 28: Temperature Register Bit Descriptions**

Bit	Description
13	Below alarm window 0: Temperature is equal to or above the lower boundary 1: Temperature is below alarm window
14	Above alarm window 0: Temperature is equal to or below the upper boundary 1: Temperature is above alarm window
15	Above critical trip point 0: Temperature is below critical trip point 1: Temperature is above critical trip point

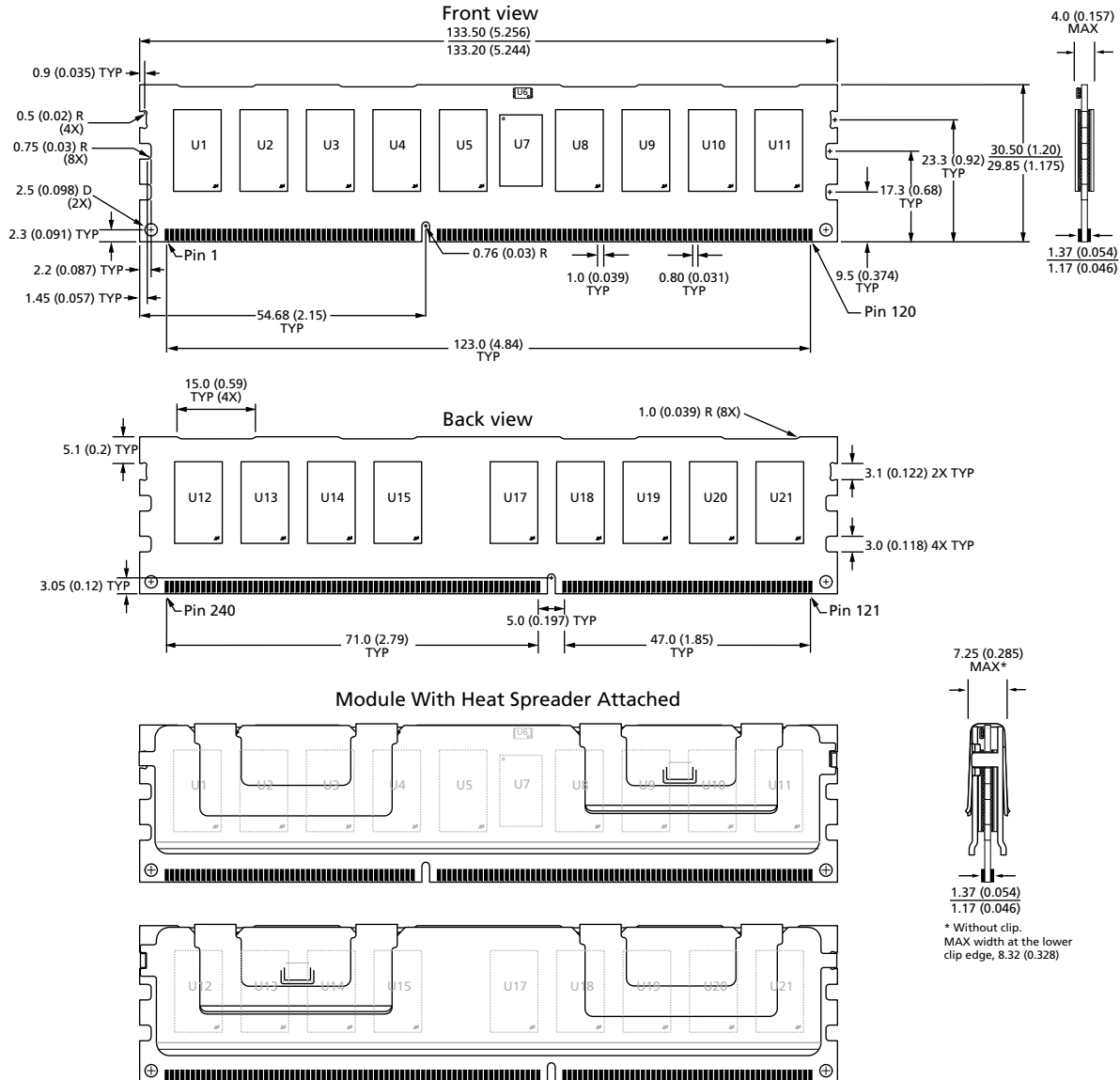
### Serial Presence-Detect Data

For the latest serial presence-detect data, refer to Micron's SPD page:  
[www.micron.com/SPD](http://www.micron.com/SPD).



## Module Dimensions

Figure 5: 240-Pin DDR3 RDIMM



- Notes: 1. All dimensions are in millimeters (inches); MAX/MIN or typical (TYP) where noted.  
 2. The dimensional diagram is for reference only.

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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.