

Temperature Definitions and Terms of DRAM memory module

Introduction

This application note introduces a general method and the criteria for measuring and ensuring that memory modules operate below their maximum allowable temperature. The specified temperatures will help ensure the reliability and functionality of Silicon Power memory modules as defined in the product data sheets.

Operating Temperature TOPER of memory modules is the case temperature (Tc) on the center / top side of the DRAM component, as defined by JEDEC JESD51-2 standards.

The primary consideration for the functionality and reliability of semiconductor products is the junction temperature (Tj) each DRAM component vendor. The Maximum Junction Temperature is essential that each device operates below the defined junction temperature to ensure proper functionality and long-term reliability of the device.

Temperature Definitions and Terms

■ Junction Temperature (TJ)

The Junction Temperature (TJ) is probably the most difficult to measure, but is the most important to understand or be able to estimate to ensure functionality and reliability of the product. DRAM memory component vendors provide the warranty of the Maximum Junction Temperature for each device.

■ Case Temperature (TC)

The case temperature should be measured by attaching a thermocouple to the top center of the DRAM component. This should be done with a 1mm bead of conductive epoxy, as defined by the JEDEC JESD51-2 standards. The case temperature can then be used to estimate the junction temperature.

■ Operating Temperature (TOPER)

Operating Temperature TOPER of memory modules is the case temperature (Tc) on the center / top side of the DRAM, as defined by JEDEC JESD51-2 standards.

1 DDR4 DRAM Component Operating Temperature (TOPER) commercial temperature grade

Symbol	Parameter	Rating	Unit	Notes
TOPER	Normal Operating Temperature Range	0 to 85	°C	a
	Extended Temperature Range	85 to 95	°C	b

2 DDR4 DRAM Component Operating Temperature (TOPER) of DDR4 memory module Industrial Wide Temperature grade (Notes: c)

Symbol	Parameter	Rating	Unit	Notes
TOPER	Normal Operating Temperature Range	-40 to 85	°C	a, c
	Extended Temperature Range	85 to 95	°C	b, c

3 DDR3 DRAM Component Operating Temperature (TOPER) of DDR3 memory module commercial temperature grade

Symbol	Parameter	Rating	Unit	Notes
TOPER	Normal Operating Temperature Range	0 to 85	°C	a
	Extended Temperature Range	85 to 95	°C	b

4 Notes:

- a 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 - 85°C under all operating conditions.
- b 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:
 - i Refresh commands must be doubled in frequency, therefore reducing the Refresh interval tREFI to 3.9 μ s. It is also possible to specify a component with 1X refresh (tREFI to 7.8 μ s) in the Extended Temperature Range. Please refer to the DIMM SPD for option availability
 - ii 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 A6 = 0b and MR2 A7 = 1b) or enable the optional Auto Self-Refresh mode (MR2 A6 = 1b and MR2 A7 = 0b).
- c Support for the Industrial Wide Temperature grade memory module is optional.