

Screening for Extended Temperature Operation of DDR3 & DDR2 SDRAM Memory

Temperature screening of commercial-grade memory is a proven cost effective way to produce extended temperature memory modules that are available with short production lead times. The following chart shows a summary of benefits using temperature screened memory module over memory modules using industrial-grade DRAM devices.

DDR3 & DDR2 EXTENDED TEMPERATURE MEMORY MODULE COMPARISON			
	FACTORY EXTENDED TEMP. MODULE	EXTENDED TEMP. MODULE BUILT WITH INDUSTRIAL DRAM	EXTENDED TEMP. MODULE SCREENING
Cost	High	High	< 40%
Availability	Min. MOQ Build to order 8 weeks lead-time	Min. MOQ Build to order 8 weeks lead-time	Any quantity No MOQ 3-4 weeks lead-time

The temperature range for screening is typically the industrial temperature E2 range from -40 to +85 °C. Memory modules screened for industrial temperature are suitable for high reliability requirements such as rugged COTS computers, industrial computers, mobile PCs, embedded Single Board Computers (SBCs), telecommunication servers, networking appliances, military-aerospace systems, medical and science research instrumentation.

The screening of memory modules usually occurs at the time manufacture. They are tested at both ends of the temperature range over a specified period of time while the test computer is operating a software diagnostic tool. This “active” burn-in, also call Test During Burn In (TDBI) will screen out potentially weak DRAM on the memory modules. A “passive” burn-in approach on unpowered modules, is not used a screening technique because DRAM components must be powered on to frequently “refresh” the data.

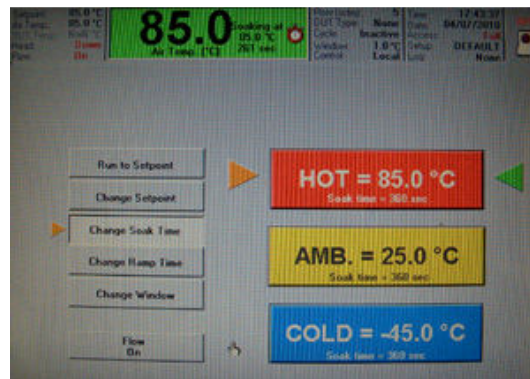


Testing Memory Modules at - 40°C



Testing Memory Modules at + 85°C

IEEE has conducted a study which concluded that DRAM devices can be “uprated” for elevated temperature and used outside the manufacturer-specified temperature range for extended periods of time [1]. Virtium has logged thousands of test hours with significant test data to show that temperature screening of commercial-grade memory modules (0 to +70°C) is a viable alternative to memory modules made with more expensive industrial grade memory devices (-40 to +85 °C).



Environmental Stress Testing

The premise that temperature screening is a viable alternative is based in the fact that there is a certain amount of overating on the absolute maximum ratings and recommended operating conditions specified in DRAM data sheets.

- 1) Absolute maximum ratings (AMR) are limits for the “reliable” use of parts.
- 2) Recommended operating conditions are the conditions for which electrical functionality and specifications are guaranteed.

This indicates that the device temperature ratings are set for electrical performance reasons as opposed to package or device reliability reasons. The part temperature ratings are designated in the recommended operating conditions for parts. The limits for reliable operation of parts are designated by the absolute maximum ratings, but use at AMR conditions do not imply catastrophic failure. Almost all data sheets contain some form of warning statement or disclaimer to discourage or prohibit use of the parts at or near absolute maximum ratings.

None of these warnings point to any catastrophic failure at the AMR condition:

- 1) These are stress ratings only.
- 2) Stresses above these ratings can cause permanent damage to the parts.
- 3) Functional operation is not implied in these ranges.
- 4) Exposure to these conditions for extended periods may affect reliability and reduce useful life.

In addition to the extended temperature screening methodology mentioned above, there are two Bill of Material (BOM) items that are part of the design for temperature screened memory modules. The first is the use selected stabilized DRAM die revisions from the DRAM device manufacturers and the other is the use of high speed DRAM for improved timing margins.

Beyond extended temperature screening, there are additional accoutrements that often accompany memory modules. These enhancements provide further protection in environments with high moisture, humidity, shock, vibration or low flow air cooling:

- ✓ Conformal Coating, Type 1B31 Arcylic, MIL-I-46058 Rev. C. Type AR
- ✓ Under-fill, Epoxy based
- ✓ Thermal Sensor, SPD defined for increase DRAM refresh rate or fan speed
- ✓ Thermal Heat Spreader and/or Heat Sink, anodized aluminum



Thermal Heat Spreader



Thermal Heat Sink

Reference and Additional Information

- [1] IEEE-Uprating of a Single Inline Memory Module
<http://ieeexplore.ieee.org/iel5/6144/21770/01010016.pdf?arnumber=1010016>
(Paper is also available upon request from Virtium Technology)
- [2] Use and Abuse of Test Time Exaggeration Factors
<http://www.tti4edu.com/hieberartc.html>

ABOUT VIRTUUM

Since 1997, Virtium memory solutions have been integrated by leading computer manufacturers around the globe, in a wide variety of challenging industries where performance and reliability are paramount, including communications, energy, industrial automation, infotainment, medical and military markets. Virtium combines first to market memory solutions with continuity of support for legacy memory products in older systems. Virtium provides extra-mile service to save design engineers and procurement professionals time and money. Virtium delivers a worry-free experience.

Its memory module product line encompasses a wide range of densities and data transfer rates in all major memory product categories including DDR3 and DDR2 MiniDIMM, VLP MiniDIMM, VLP Unbuffered Mini-DIMM, VLP Registered Mini-DIMM, SO-UDIMM, SO-RDIMM, ECC SODIMM, Mini-UDIMM and Mini-RDIMM, together with enhancements needed in challenging environments.

Headquartered in Southern California, Virtium is a privately held, financially-sound technology company with U.S. based design and manufacturing facilities certified to ISO 9001:2000 and AS9100 Rev. B. Virtium maintains representative offices throughout the U.S., Europe and Asia. For more information, call toll-free at 1-888-VIRTUUM (1-888-847-8486) or visit Virtium Technology online at <http://www.virtium.com>.