

HIGH RELIABILITY MEMORY MODULE FEATURES, APPLICATIONS & ENVIRONMENTS

Whitepaper

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Abstract

Viking Technology manufactures DRAM modules for OEMs in Enterprise, Telecommunications and Industrial markets. It offers Full DRAM technology portfolio from DDR4 to Legacy DDR1. Viking's modules follow JEDEC standard and range from Standard Form Factors to the most comprehensive small form-factor and Specialty custom modules. Viking's DRAM memory modules are designed to meet extreme temperatures, high reliability, long life requirements for the most demanding designs and applications.

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High Reliability Memory Module Features, Applications, Environments

1 Introduction

Memory solutions must provide reliable operation even in the most extreme conditions (e.g., temperature, shock, and vibration). Viking's memory and storage solutions are the perfect fit for such demanding applications. They offer the highest reliability and quality with long term availability and controlled BOM. To guarantee such high quality standards, each product undergoes thorough functional testing before being released for shipment.

Viking provides memory modules to fulfill at the industrial implementations below. These industrial segments share some common requirements:

1. Industrial Temperature Support (-40°C to +85°C).
2. ESD, vibration and humidity resistance.
3. Low power and long product life cycle.
4. Wide ranges of capacities.
5. Multiple form factors.
6. Legacy support.
7. ROHS and JEDEC compliance.

2 Product Features

- 1. Multiple temperature support:** Viking's memory modules are designed and approved for reliable operation for wide temperature range. The products are verified at temperature corners and pre-stressed with a burn-in operating functional test called as Test during Burn in or TDBI. Depending on the application and customers' requirement Viking modules can be built to support high temperature ranges from -40°C to +95°C or even higher. Viking's memory is available in three different temperature ratings.

- a. **Standard:** 0°C to +85°C
 - b. **Extended:** -25°C to +95°C
 - c. **Industrial:** -40°C to +95°C
2. **ESD and EMI Safe:** The modules are in line with the latest regulations for electrostatic discharge (ESD) and electromagnetic interference (EMI). Viking has proper system and methods in place to test memory modules for these parameters. It also has in house technology such as patented stacking technology to stack dies together to increase density and multi chip package, a.k.a. MCP.
3. **Ruggedized option:** Viking offers memory solutions for ruggedized applications. Viking's ruggedized solution offers advanced small form factor features such as 30u" gold finger, heat spreaders, conformal coating, thermal sensors and under fill. Because of this options Viking's memory modules can operate in harsh environments with shock and vibration and extreme temperature such as industrial temperature.
4. **Conformal Coating:** Viking offers a special protective coating as and when required by the customers. This coating is a thin polyurethane film. Viking uses HumiSeal® 1A33 as a conformal coating material. A Conformal coating is a protective chemical coating or polymer film 25-75µm thick (50µm typical) that 'conforms' to the circuit board topology. Its purpose is to protect electronic circuits from harsh environments that may contain moisture and or chemical contaminants. By being electrically insulating, it maintains long-term surface insulation resistance (SIR) levels and thus ensures the operational integrity of the assembly. It also provides a barrier to air-borne contaminants from the operating environment, such as salt-spray, thus preventing corrosion. Modules with conformal coating are generally required in ruggedized applications such as military, automotive and aerospace, where coatings are used to protect against various combinations of moisture, aggressive chemical and vapors, salt sprays, large temperature variations, mechanical vibrations and even organic attack. The protective nature of conformal coatings also means that they not only protect, but also serve to enhance product reliability and thereby reduce the potential cost and damaging effects of early field failures.

As such their use is becoming increasingly common in consumer and domestic applications that can be susceptible to environmentally-induced field failure; including portable devices comprising fine pitch, densely populated assemblies, such as mobile phones, through to washing machines. It can be applied on the substrate in three different ways as described below.

- 1) **Dipping:** Depending on the complexity, density and configuration of components on the assembly, it may be necessary to reduce the viscosity of HumiSeal® 1A33 with HumiSeal® Thinner 503 in order to obtain a uniform film. Once optimum viscosity is determined, a controlled rate of immersion and withdrawal (5-15 cm/min) will further ensure even deposition of the coating and ultimately a uniform film. During the application, evaporation of solvent causes an increase in viscosity that should be adjusted by adding small amounts of HumiSeal® Thinner 503. Viscosity in the dip tank should be checked regularly, using a simple measuring device such as a Zahn or Ford viscosity cup.
- 2) **Spraying**
HumiSeal® 1A33 can be sprayed using conventional spraying equipment. Spraying should be done in an environment with adequate ventilation so that the vapor and mist are carried away from the operator. The addition of HumiSeal® Thinner 521 or 521EU is necessary to ensure a uniform spray pattern resulting in pinhole-free film. The amount of thinner and spray pressure will depend on the specific type of spray equipment used and operator technique. The recommended ratio of HumiSeal® 1A33 to HumiSeal® Thinner 521 or 521EU is 1:1 by volume; however the ratio may need to be adjusted to obtain a uniform coating.
- 3) **Brushing**
HumiSeal® 1A33 may be applied by brush. Uniformity of the film depends on component density and operator's technique.
5. **Heat Spreader:** Viking provides DRAM modules with heat spreader as per customers' requirement. Heat spreader allows temperature hot spots to be dissipated over a large surface area and improve the module's reliability.
6. **Shock and Vibration:** Viking modules are built to highest quality to operate in robust and ruggedized environment. The design, assembly and use of selected materials guarantee an extremely solid design, which has been validated by extensive testing, so modules operate reliably in industry and military environments and can absorb shock and vibration.
7. **Temperature Sensor:** The sensor allows the hardware or software to monitor memory module temperature to improve data reliability in the target application environment especially in ruggedized applications. There are two different types of temperature sensors, which are fully compliant with JEDEC JC42.4 and are used in DIMM modules. 1) TSE2002 family of EEPROM devices with integrated thermal sensor and 2) TSE3000 family of standalone thermal sensors. Though not technically an SPD device, the TS3000 families of sensors are defined to be compatible with modules using SPD devices. The TSE2002 family of EEPROM

device with integrated thermal sensor is a digital temperature sensor with accuracy up to $\pm 0.5^{\circ}\text{C}$ is used to target applications demanding highest level of temperature readout. The device also contains 512 Byte EEPROM for storage of vendor information and system configuration such as SPD for DIMM modules. Figure-1 shows the application of temperature sensor in memory module.

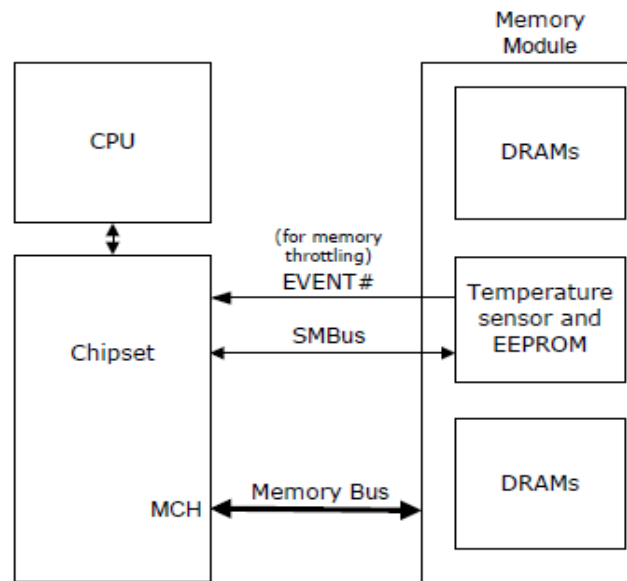


Figure-1: Memory Module Temperature Sensor Application

The digital temperature sensor comes with several user-programmable registers to provide maximum flexibility for temperature-sensing applications. The registers allow specifying critical, upper and lower temperature limits as well as hysteresis settings. Both the limits and hysteresis values are used for communicating temperature events from the chip to the system. The sensor uses an industry standard 2-wire, I²C/SMBus [Figure-2] serial interface and allows up to eight devices to be controlled on the bus.

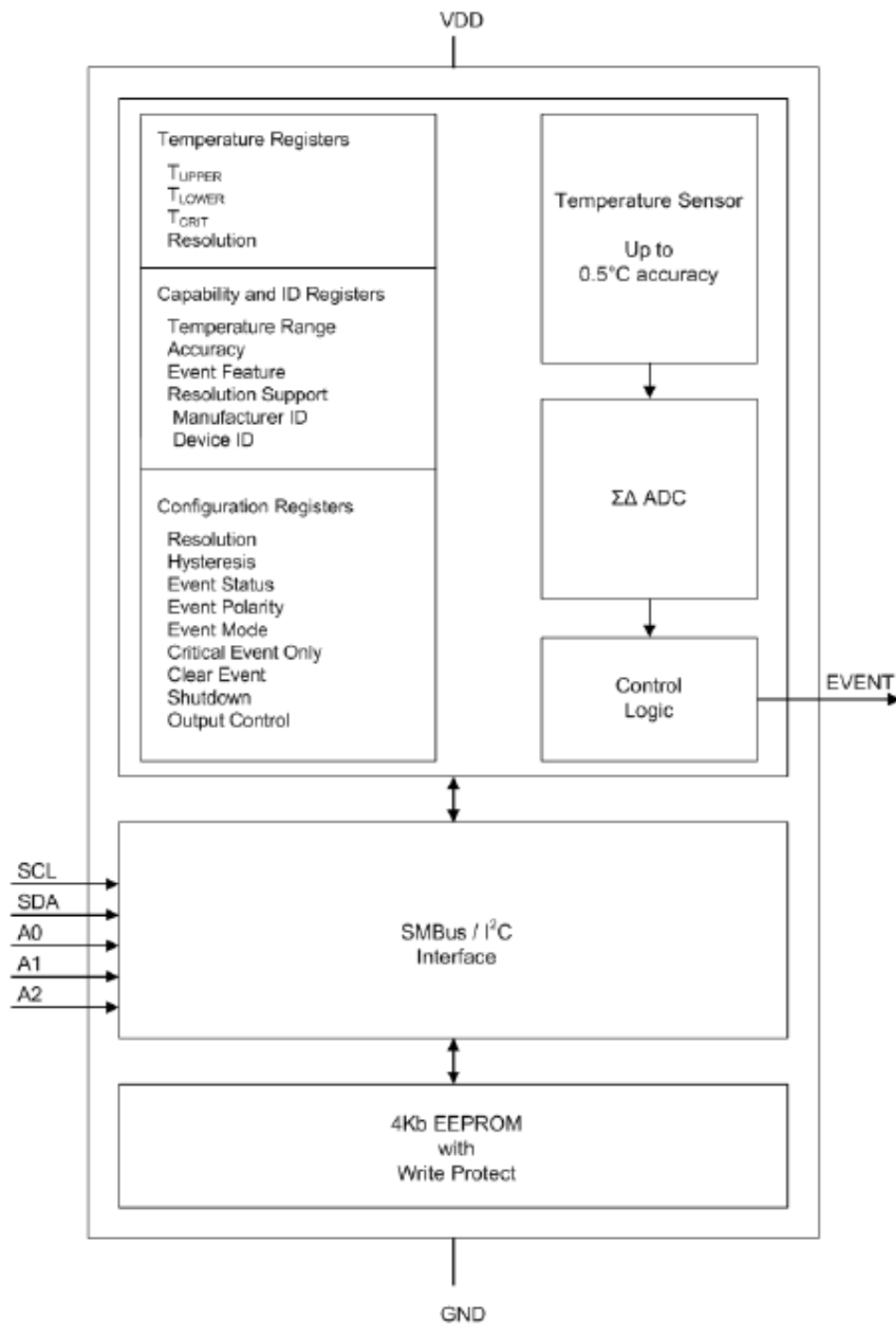


Figure-2: Block Diagram of Temperature Sensor with EEPROM

Temperature Sensor Features

- Temperature converted to Digital Data.
- Sampling rate of 125ms.
- Selectable 0, 1.5C, 3C, 6C Hysteresis.
- Programmable resolution from 0.0625C to 0.5C
- Accuracy:
 - $\pm 0.5^{\circ}\text{C}$ / $\pm 1^{\circ}\text{C}$ (typ/max) from $+75^{\circ}\text{C}$ to $+95^{\circ}\text{C}$
 - $\pm 1^{\circ}\text{C}$ / $\pm 2^{\circ}\text{C}$ (typ/max) from $+40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
 - $\pm 2^{\circ}\text{C}$ / $\pm 3^{\circ}\text{C}$ (typ/max) from -40°C to $+125^{\circ}\text{C}$

Applications

- DDR3/DDR4 DIMM modules.
- Servers, Laptops, Ultra-portable devices, PCs, etc.
- Industrial temperature monitors.
- Hard disk drives and other PC peripherals.

3 Product Quality

Quality is the key differentiator at Viking Technology. Our Quality professionals have extensive experience in Quality systems and memory applications with technical degrees, ASQ certifications and with standard 10 years experience in quality assurance. Viking Technology follows specific guidelines for the memory industry in additions to Sanmina's strict Quality Policies with over 206 Standard operating procedures (SOP) just for ISO9001 alone. Whether we're designing and prototyping products, launching new products, deploying the personnel needed to meet a customer's demand or delivering shipments to a major global market, we take every measure to ensure quality, excellence and industry-leading processes throughout every Viking Technology operation. Because of In-house Sustaining Qualification & Validation:

- Key strategic advantage for OEM customers
- Relieves burden on customer engineering resources (Design/test/quality)
- NPI and prototyping

Advanced Capabilities include:

- Enhanced & customized testing
- Environmental stress screening
- Locked BOM
- Long-term supply support (beyond LTB/LTS)
- Inventory supply management and logistics
- Extended test capabilities
- Extreme temperature solution development beyond 120°C
- Ruggedization, miniaturization, and custom form factors

While building memory modules, Viking facility takes utmost care of quality and reliability. Quality measures that Viking takes care of include following:

- Real-time monitoring of field DPPM
- Weekly reviews of MRB with closed loop feedback action
- Weekly monitoring of First pass yield, RTY, scrap, in process defects
- Bi-annual CSI monitoring of customer satisfaction
- Quarterly SSI monitoring of all suppliers
- Environmental awareness with ISO 14001
- Corporate CSR
- Certified to ISO 9001, TL 9000, ANSI ESD 20.20, IPC-A-610 F, and AS 9100
- In-house reliability tools and thermal-cycle, shock chambers
- Local MIL 810 testing and certification available
- MTBF calculation using the Belcore modeling method
- In-house Failure Analysis
- All inspectors IPC CERTIFIED
- All QE's have ASQ certifications
- In-house designed test programs

4 Applications

Viking's memory solutions are built to provide reliable operation even in the most extreme conditions such as temperature, shock and vibration. As such, both qualification cycle and the support life cycle needed for these products far exceed those of devices designed for consumer applications. Viking memories are used in vast variety of applications be it in Networking or in Automotives. Almost every application would use Viking's memory. List of some of applications in various industries is as follows.

- Networking
 - Servers and Storage applications
 - Cable modem

- Content and Video Delivery
 - Switches and Routers
 - Optical Network
 - Enterprise Media gateway
- Industrial Automation
 - Process/Motion Control
 - Industrial PC/Embedded application
 - Industrial Measurement
 - Building Technology
 - Surveillance
 - Oil/Gas: Oil field, Oil Rig, Down hole Data Acquisition
- Energy
 - Smart Grid
 - Energy distribution
- Infotainment
 - Information terminals
 - Ticket terminals
 - Digital Advertising
 - Casino gaming
 - Vending terminals
- Aerospace and Defense
 - In-flight entertainment and communication
 - Radar, GPS and Communication
 - Communication, Command, Control and Intelligence
 - Combat Management system.
 - Battlefield sensor system
- Automotive
 - Entertainment Systems
 - Navigation systems
 - Automotive dashboards

5 Conclusion

If your business specializes in finance, military application, automotives, healthcare or datacenters and the server crashes while processing a transaction due to a memory failure, the transaction would be lost. Memory failures could also lead to data transcription errors, where a number is changed or a decimal is misplaced. In this scenario, you may not even know the error has occurred. It could be days or weeks before that transaction is next reviewed. Even then it may still not get caught by whoever is reviewing it. In such situation and/or harsh environment application, high reliability modules have added benefit. Extra features and benefits of Hi-Reliability products improve the Total Cost of Ownership. Since added features and the process

steps required to manufacture Hi-Reliability modules involve extra cost and can be little expensive than commercially available modules, customers should not view this extra cost as an expensive, however, it should be seen as an investment for long life cycle of modules in the field. Replacement of modules due to short life cycle or failures is more costly than initial investment in Hi-Reliability modules. Over time this investment will pay off when customer will see longer life cycle and no failures in the field.

References

1. <http://www.humiseal.com/products/urethanes/1a33/>
2. <https://www.idt.com/products/memory-logic/memory-interface-products/ddr3-solutions/tse2002gb2a1-temp-sensor-integrated-eeeprom-memory>

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