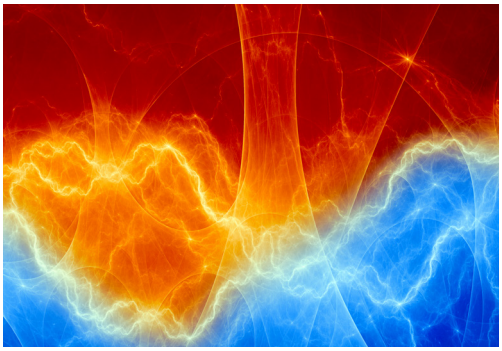
White Paper

Enabling Industrial AIoT with Wide Temperature DRAM



Executive Summary

Some of the most important potential uses of AIoT are in industrial and harsh environments where components have to withstand extreme temperatures for extended periods. Since such environments are challenging for both humans and machines, they serve as a critical next frontier for computing as it expands into every part of our world.

Innodisk's wide temperature DRAM operates within the range of −40 to 85 °C and enables AIoT solutions in extreme environments. These modules are designed to tackle harsh environmental conditions seen by AIoT applications such as in-vehicle, factories, networking, and outdoor kiosks, as well as in the surveillance and defense markets.

Innodisk's bases its wide temperature specifications on the JEDEC standards for DRAM integrated circuits (IC), with the JEDEC Standard 21C outlining the specifications for standard DRAM modules. These standards outline the basic specifications of wide temperature DRAM, and, together with testing procedures and quality control, it lays the groundwork for how to design industrial-grade, wide temperature memory ready for the future of AIoT.

Introduction

Memory is an essential component in every computer, no matter its size and application. All memory installed in edge devices must, therefore, be ready to tackle any thermal and physical hardship posed by their environment.

Such quality of such industrial-grade memory is only increasing in importance as we move more and more of our computing power to the edge, where AIoT devices collect and process an ever-growing amount of data. Where good memory can withstand harsh conditions while also decreasing latency and helping create a more efficient system, poorly selected memory risks jeopardizing innovative AIoT applications when faltering under its operating conditions.

What the move toward AIoT means is that system integrators now place data-processing devices where the actual data is gathered instead of in a centralized and more stable location. These locations where data is gathered and processed can be anything from a factory floor, a busy road intersection, to onboard a ship or an airplane. One of the main challenges that tie these applications together is the wide temperature variations.

This paper explains the background of DRAM wide temperature specifications, as well as its AIoT applications and testing procedures.

Background

The specification industrial-grade wide temperature is usually defined by the temperature range −40 to 85 °C. Innodisk bases this range on JEDEC specifications and expands it further into the negative range to better suit industrial requirements.

JEDEC

JEDEC is an organization that develops open standards for the microelectronics industries. The standards are created through tight-knit cooperation between manufacturers and suppliers, and organizations worldwide use them. For standard temperature DRAM, the applicable standard is *21C*. For wide temperature, there are separate standards that outline specifications for different DRAM types. The JEDEC standards describe both manufacturing requirements and the testing of wide temperature DRAM modules in detail.

Challenges

The AIoT trend and the overall trend of edge computing both contribute to more devices and computational power being placed in harsher environments. These include both places with extreme heat and cold, as well as in areas susceptible to the adverse consequences of climate change.

For example, devices placed outside experience a continuous cycle of heating and cooling with the change from day to night, and on a longer cycle with seasonal changes. Many outside locations can also be hard to access, increasing the time and cost of maintenance.

Therefore, AIoT devices that operate in such environments must utilize memory modules that can handle these challenging conditions over long periods with minimal attendance.

Solutions

JEDEC Standards

The JEDEC Standard specifies the temperature range for the whole DRAM module and DRAM integrated circuits (IC), respectively. Innodisk follows this guideline, which also states that maximum T_C shall not exceed the value specified for the DRAM component.

The temperature range for DRAM modules is designated as T_A, which refers to the ambient temperature. JEDEC puts this range at:

$$0°C \leq T_A \leq 55°C$$

The case temperature (T_C), which refers to the temperature of the IC during operations, is always higher as it is at least the same as the ambient temperature with heat produced during operations added on top, i.e., T_C is equal to T_A plus heat produced. JEDEC sets this range to:

$$0°C \leq T_C \leq 85°C$$

The Innodisk standard for wide temperature modules based on the JEDEC standard and is further extended into the negative range:

$$-40°C \leq T_A \leq 85°C$$

This range allows modules to operate in environments that significantly surpass the JEDEC standard, both for ambient and IC temperature (as T_C is always the same or higher than T_A).

Testing and Quality Control

Modules are run through a standardized testing process to verify wide temperature capability, as well as robustness and overall product quality, as seen below.

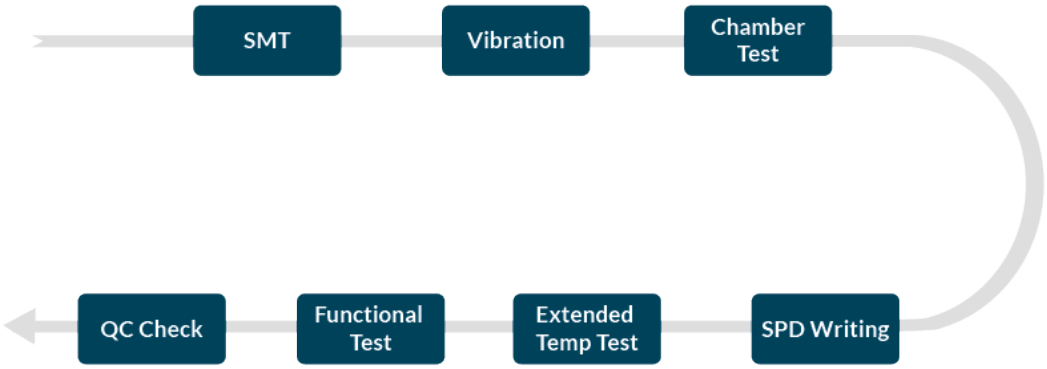


Figure 1: Wide temperature testing process.

Once clearing this process, the modules are verified for use in wide temperature environments such as those faced by many AIoT devices.

Conclusion

Wide temperature specifications are crucial in ensuring that your AIoT or edge device survives the extreme conditions seen in the surveillance, in-vehicle, factory, networking, and mission-critical markets. The need for wide temperature memory is set to increase as computational power moves out into the field where robust AIoT devices are essential for longevity and efficient maintenance.

Wide temperature plays a part in the broader set of tools that prepare memory for harsh environments. Combining wide temperature capabilities with technologies such as anti-sulfuration, coating, side fill, and heat spreaders allow the operator to tailor a solution specific to their application.

Innodisk Corporation

5F., NO. 237, Sec. 1, Datong Rd., Xizhi Dist., New Tapei City, 221, Taiwan
Tel : +886-2-7703-3000
Fax : +886-2-7703-3555
E-Mail : sales@innodisk.com
Website : www.innodisk.com