Application Note

AM64x/AM243x Extended Power-On Hours

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ABSTRACT

This application report provides guidelines for extending the operational lifetime of an AM64x and AM243x device from 100k Power-On Hours (POH) up to 200k POH. The data provided are operational lifetime estimates and do not ensure the lifetime of the device.

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Trademarks

1 Introduction

Many industrial applications require systems to operate 24 hours a day and seven days a week for several years. To keep those industrial systems in operation, it is important to be able to predict the wear-out of the systems so the equipment can be serviced and maintained to try to prevent a failure during normal operation. The semiconductor devices that are designed into those systems have typically been expected to reach estimated lifetimes of 100k POH at maximum junction temperature (T_j). Now, with a demand for reduced maintenance, industrial systems must meet even longer operational lifetimes. To help facilitate this at the semiconductor component level, this document details the requirements and limitations to extend the estimated operational lifetime of the AM64x processor and AM243x microcontroller from 100k POH up to 200k POH.

2 Wear-Out Mechanisms

Calculating Useful Lifetimes of Embedded Processors provides a methodology for calculating the useful lifetime of TI embedded processors under power when used in electronic systems. It discusses the stages of reliability, the useful life period, and complementary metal-oxide semiconductor (CMOS) wear-out mechanisms. The primary wear-out mechanism discussed in the application note was electro-migration.

As each semiconductor process node is unique, some wear-out mechanism may affect the estimated lifetime of the devices in different ways.

For the AM64x/AM243x, the following CMOS wear-out mechanisms were evaluated to extend the estimated operational lifetime of the device:

- Electro-Migration
- Gate Oxide Integrity
- Negative Bias Temperature Instability
- Channel Hot Carrier

The guidelines detailed in the next section were generated as a result of that evaluation.

3 Guidelines for Extended POH

For extended POH up to 200k POH (greater than 20 years), the same notes apply as listed for 100k POH in the *Power-On Hours (POH)* section in the *AM64x Sitara™ Processors Data Manual* and in the *Power-On Hours (POH)* section in the *AM243x Sitara™ Microcontrollers Data Manual*.

As noted in the data manuals, AM64x and AM243x achieve an estimated 100k POH with T_j in industrial temperature range of -40°C to 105°C.

Extended POH estimates up to 200k POH are stated in Figure 3-1 for continuous processor operation. An estimated 200k POH can be targeted for systems by maintaining T_j in range of -20°C to 85°C. Note that there are estimates from 100k and 200k POH between 105°C and 85°C and between -40°C and -20°C, respectively, that can be utilized for extended lifetime profiling as well.

Junction Temperature (degrees C)	Power-On Hours
105	100000
100	123000
95	153000
90	191000
85	200000
●	
●	
●	
-20	200000
-25	170000
-30	143000
-35	120000
-40	100000

Figure 3-1. Extended Power-On Hour Estimates Over Junction Temperature

4 Summary

Adjusting the thermal design of the system to allow junction temperature in a narrower range can allow systems to reach significantly longer operational lifetimes. With some careful design considerations, the AM64x processor and AM243x microcontroller can enable estimated POH up to 200k hours.

5 References

- *Calculating Useful Lifetimes of Embedded Processors*
- *AM64x Sitara™ Processors Data Manual*
- *AM243x Sitara™ Microcontrollers Data Manual*

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