Application Report
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AM574x Extended Power-On Hours (POH)

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ABSTRACT

This application report provides guidelines for extending the operational lifetime of an AM574x device from 100k Power-On Hours (POH) up to 200k POH. The data provided are operational lifetime estimates and do not guarantee the lifetime of the device.

Contents

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 (Tj). 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 AM574x processor 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 AM574x, 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 restrictions apply as noted for 100k POH in the *Power-On Hours Limits* section of the *AM574x Sitara™ Processors Silicon Revision 1.0 Data Manual* (SPRS982).

In addition to restrictions noted for 100kPOH at T_J = 105°C in the AM574x data manual, the following restrictions also apply to enable POH greater than 100k hours:

- MPU (Arm Cortex A15) operation only at nominal (OPP_NOM) or overdrive (OPP_OD) operating points
  - No OPP_HIGH operation for the MPU voltage domain
  - No restrictions on OPP's for other domains
- To extend POH to 200k POH, Tj must be ≤90C for at least 50k hours of the extended operational profile
- All 24-bit VOUT display interfaces must be enabled only at 1.8V to allow up to 200k POH
  - VOUT operation at 3.3 V is allowed up to 100k POH at T_J = 105°C
  - Other input/output interfaces multiplexed on VOUT pins may be enabled at 3.3 V with appropriate tolerance up to 200k POH
- All LVCMOS interfaces operating at 3.3 V must be constrained to 3.3 V DC+2% or reduced to 1.8 V operation
- No MMC4 interface operation beyond 100k POH. There are three other MMC interfaces on AM574x that can be used for extended operation up to 200k POH.

4 Summary

With some careful design considerations, the AM574x processor can enable estimated POH up to 200k hours. Adjusting the thermal design of the system to allow slightly lower junction temperature and careful consideration of LVCMOS interface design can allow systems to reach longer operational lifetimes using the AM574x.

5 References

- *Calculating Useful Lifetimes of Embedded Processors*
- *AM574x Sitara™ Processors Silicon Revision 1.0 Data Manual* (SPRS982)

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