NXP Semiconductors
Application Note

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i.MX 6SLL Product Lifetime Usage Estimates

Contents

1 Introduction

This document describes the estimated product lifetimes for the i.MX 6SLL applications processor based on the criteria used in the qualification process.

The product lifetimes described here are estimates and do not represent a guaranteed lifetime for a particular product.

The i.MX 6 series consists of an extensive number of processors that deliver a wide range of processing and multimedia capabilities across various qualification levels.

This document is intended to provide users with guidance on how to interpret the different i.MX 6SLL qualification levels in terms of the target operating frequency of the device, the maximum supported junction temperature (Tj) of the processor, and how this relates to the lifetime of the device.

Each qualification level supported (commercial and industrial) defines a number of power-on hours (PoH) available to the processor under a given set of conditions, such as:

- The target frequency for the application (commercial and industrial).
  a) The target frequency is determined by the input voltage to the processor's core complex (VDD_ARM_IN).
  b) The target voltage should not be set to the minimum specified in the datasheet. All power management ICs have allowable tolerances. The target voltage must be set higher than the minimum specified voltage to account for the tolerance of the PMIC. The tolerance assumed in the calculations in this document is +/-25mV.
- The percentage of active use vs. standby.
  a) Active use means that the processor is running at an active performance mode.
     – For the commercial and industrial tiers, there are two available performance modes: 996 MHz and 792 MHz.
  b) In standby/DSM mode the datasheet defines lower operating conditions for VDD_ARM_IN and VDD_SOC_IN, reducing power consumption and junction temperature. In this mode, the voltage and temperature are set low enough so that the effect on the lifetime calculations is negligible and treated as if the device were powered off.
- The junction temperature (Tj) of the processor.
  a) The maximum junction temperature of the device is different for each tier of the product, for example, 95^{o}C for commercial and 105^{o}C industrial. This maximum temperature is guaranteed by final test.
  b) Users must ensure that their device is appropriately thermally managed such that the maximum junction temperature is not exceeded.

NOTE

All data provided within this document are estimates for PoH that are based on extensive qualification experience and testing with the i.MX 6 series. These statistically derived estimates should not be viewed as a limit on an individual device's lifetime, nor should they be construed as a guarantee by NXP as to the actual lifetime of the device. Sales and warranty terms and conditions still apply.

2 Device qualification level and available PoH

2.1 Commercial qualification

Table 2 provides the number of PoH for the typical use conditions for the commercial device.

Table 1. Commercial qualification lifetime estimates

ARM® Core Speed (MHz)	Power-on Hours [PoH] (Hrs)	ARM Core Operating Voltage (V)	Junction Temperature [T_j] (°C)
996	21,900	1.255	95
792	48,790	1.175	95

Figure 1 establishes guidelines for estimating PoH as a function of CPU frequency and junction temperature. PoH can be read directly off of the charts below to determine the necessary trade-offs to be made to CPU frequency and junction temperature to increase the estimated PoH of the device.

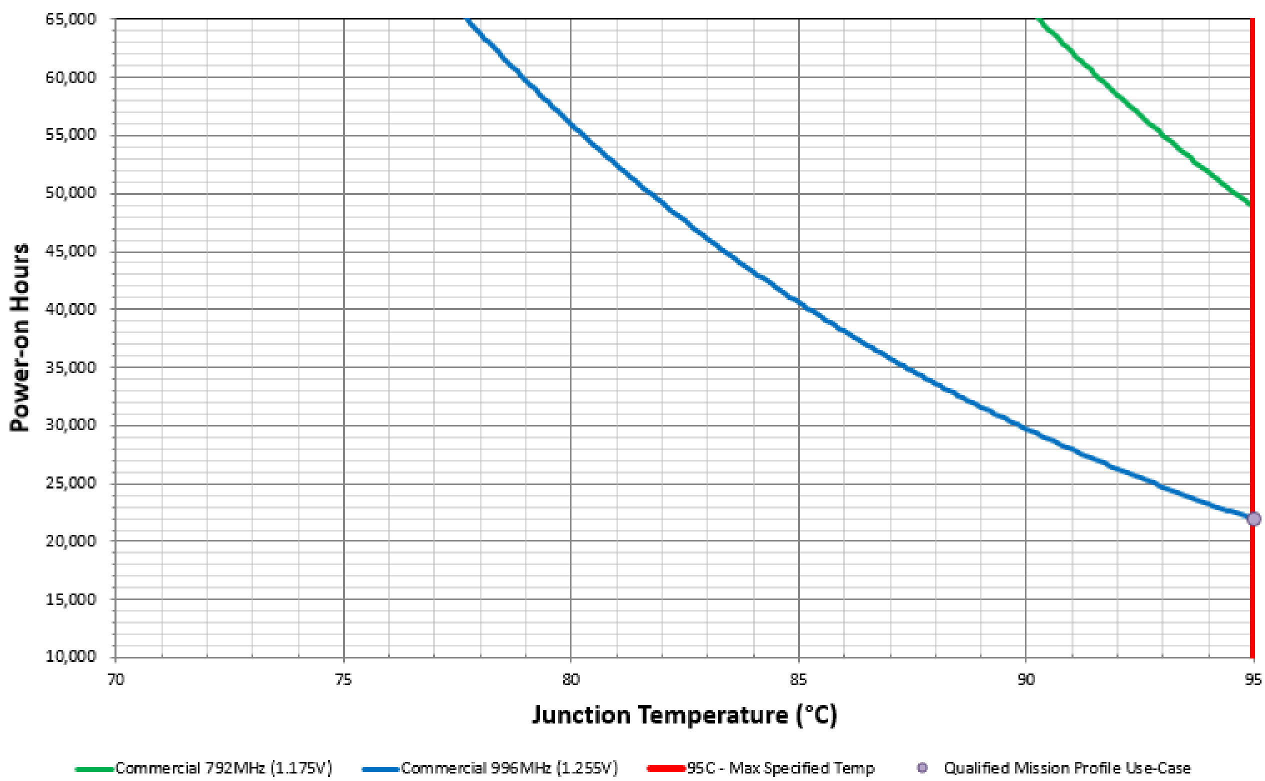

Figure 1. i.MX 6SLL commercial lifetime estimates

2.2 Industrial qualification

Table 2 provides the number of PoH for the typical use conditions for the industrial device.

Table 2. industrial qualification lifetime estimates

ARM Core Speed (MHz)	Power-on Hours [PoH] (Hrs)	ARM Core Operating Voltage (V)	Junction Temperature [T_j] (^oC)
792	87,600	1.175	105

Figure 2 establishes guidelines for estimating PoH as a function of CPU frequency and junction temperature. PoH can be read directly off of the charts below to determine the necessary trade-offs to be made to CPU frequency and junction temperature to increase the estimated PoH of the device.

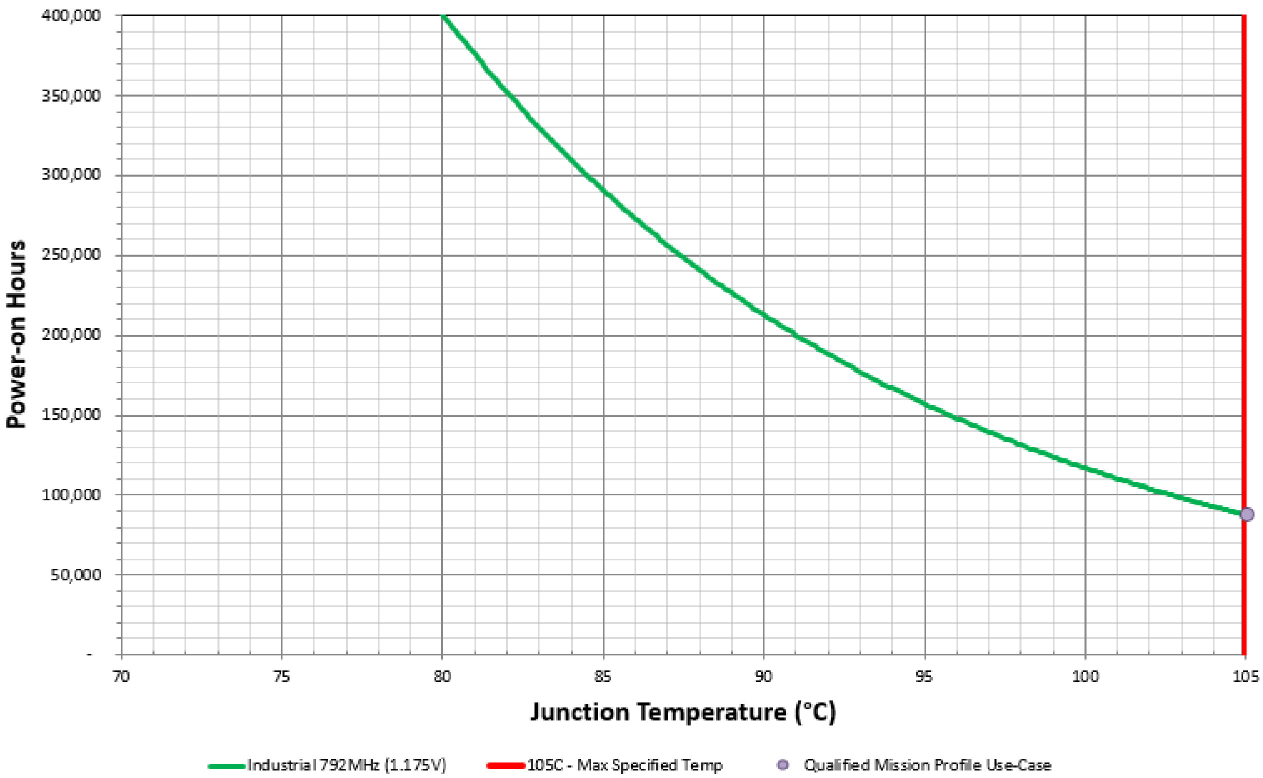

Figure 2. i.MX 6SLL industrial lifetime estimates

3 Combining use cases

In some applications a constant operating use case cannot deliver the target PoH. In this case, it is advantageous to use multiple operating conditions. This method provides some of the lifetime benefits of running at a lower performance use case, while keeping the ability of the system to use the highest performance state dictated by the application's demands.

Scenario 1: Switching between two power states with different voltages.

In this scenario, the system is using a 996 MHz full power state, and a 792 MHz reduced power state. It is assumed for these calculations that the temperature stays constant in either mode. If the system spends 50% of its power-on-time at 996 MHz and 50% of its power-on-time at 792 MHz, the two PoH (read from Figure 3) can be combined with using those percentages: 55,000 x 0.5 + 24,700 x 0.5 = 39,850 PoH.

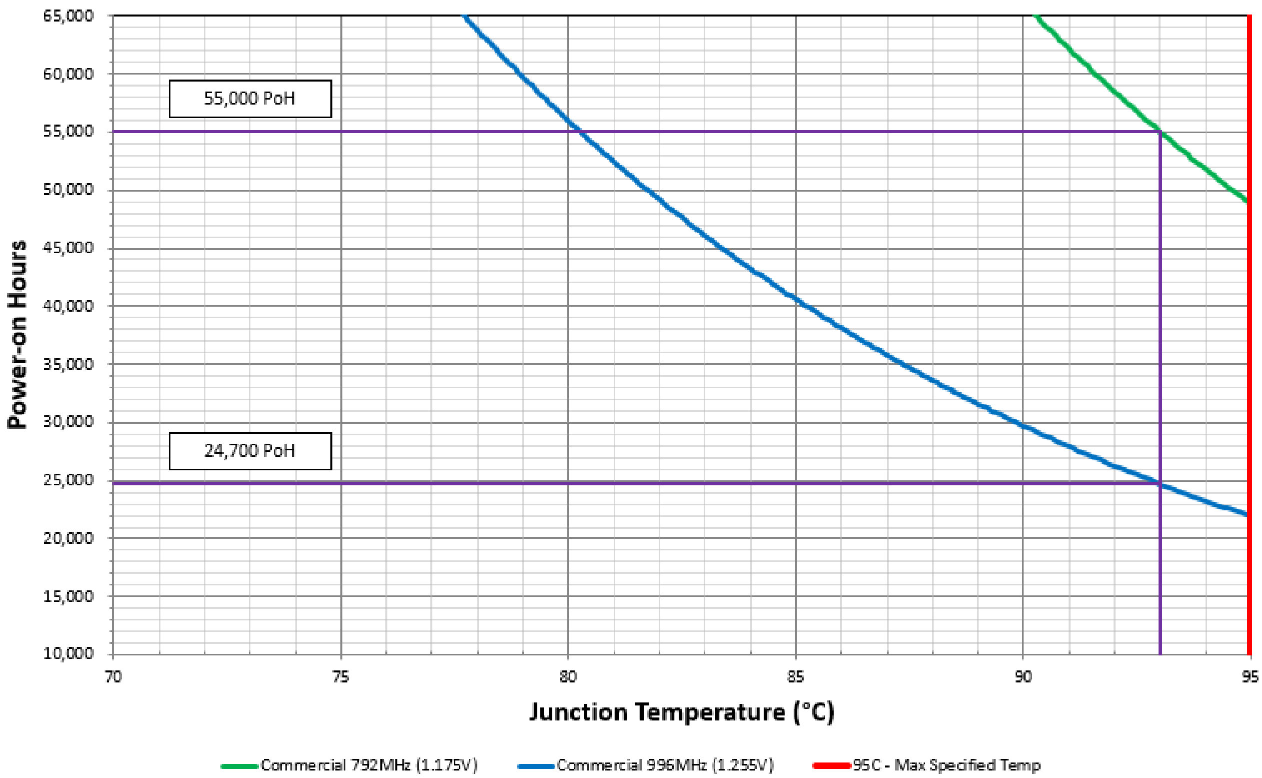

Figure 3. Multiple power state use case

Scenario 2: Switching between two power states with different temperatures

This scenario assumes that the system can achieve a drop in temperature by throttling back in performance while still maintaining a constant voltage. This temperature change may be able to be achieved by changing the frequency or by simply scaling back the loading on the ARM cores or processing units. This use case is particularly useful for customers who need to take advantage of the full commercial temperature range of the i.MX 6 series. In this scenario, the system spends 30% of its power-on-hours at 93^{o}C and 70% of its power-on hours at 85^{o}C (as read off the chart in Figure 4). The two PoH can be combined as such: 24,700 x 0.3 + 40,600 x 0.7 = 35,830 PoH.

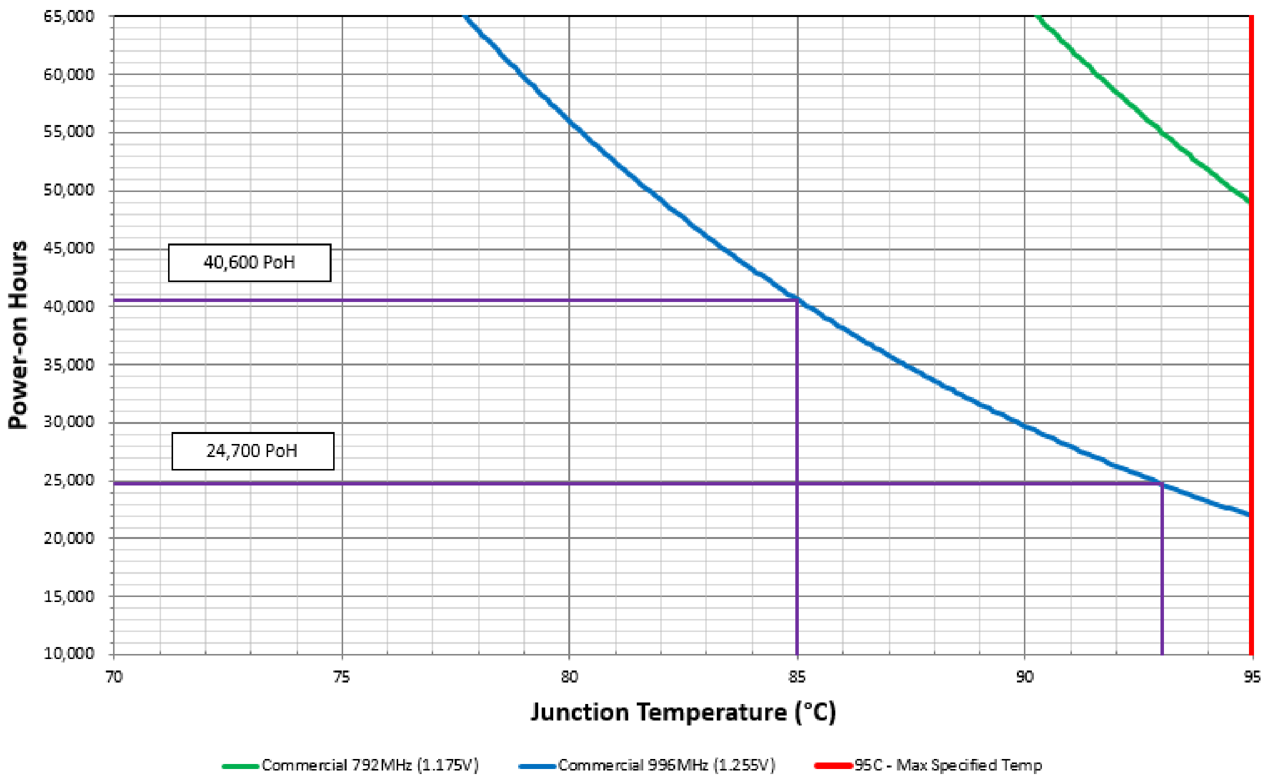

Figure 4. Multiple temperature use case

Scenario 3: Using three or more power states.

This scenario shows how this strategy can be extended to more than two power states. While this example only has three power states, there is no limit to the actual number of power states that can be combined. The power states that are being used in this scenario are 792 MHz (at 93°C) and 996 MHz (at 85°C). Each state will be used equally one third of the time. These power states can be combined as such: 55,000 x 0.34 + 40,600 x 0.33 + 24,700 x 0.33 = 39699 PoH.

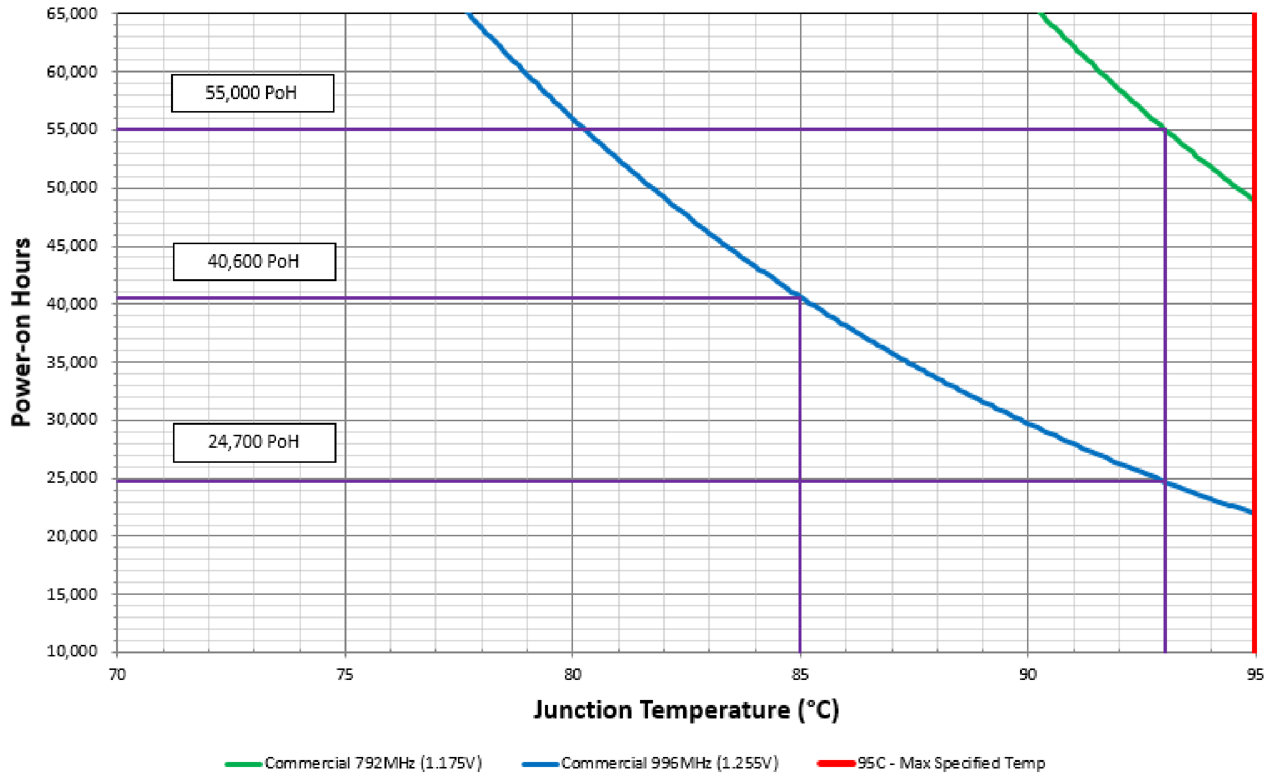

Figure 5. Various use cases

4 Revision history

Table 3. Revision history

Revision number	Date	Substantive changes
0	06/2017	Initial release.

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