NXP Semiconductors
Application Note

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i.MX 8M Dual / 8M QuadLite / 8M Quad Product Lifetime Usage

Contents

1. Introduction 1
2. Device qualification level and available PoH 1
2.1. Commercial lifetime estimates 2
2.2. Industrial qualification 3
3. Combining use cases 4
4. Conclusion 6
5. Revision history 7

1. Introduction

This document describes the estimated product lifetimes for the i.MX 8M Dual / 8M QuadLite / 8M Quad Application Processors based on the criteria used in the qualification process.

The product lifetimes described here are estimates and do not represent a guaranteed life time for a product.

The i.MX 8M Series consists of several 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 8M qualification levels in terms of the target operating frequency of the device, the maximum supported junction temperature (Tj) of the processor, and how it relates to the lifetime of the device.

2. Device qualification level and available PoH

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:

1. The target voltage for the application (Commercial and Industrial).
    a. The lifetime is limited by the SOC operating voltage.

2. The percentage of active use vs. standby mode.
   a. Active use means that the processor is running at an active performance mode.
      i. For the Commercial tier, there is only 1 active performance mode: 1.5 GHz.
      ii. For the Industrial tier, there is only 1 active performance mode: 1.3 GHz.
   b. In the standby mode, the VDD_ARM and the VDD_SOC are lowered, 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.
3. The junction temperature of the processor (Tj).
   a. The maximum junction temperature of the device is different for a given qualification level, for instance 105C for Industrial Tier and 95 C for Commercial Tier.
   b. Users must ensure that their device is appropriately thermally managed such that the maximum junction temperature is not exceeded.

All data provided within this document are estimates for PoH that are based on extensive qualification experience and testing with the i.MX 8M Series. These statistically derived estimates should not be viewed as a limit on an individual device 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.

2.1. Commercial lifetime estimates

Table 1 provides the number of PoH for the typical use conditions for the commercial device.

Table 1. Commercial qualification lifetime estimates

Arm Core Speed	Power-on Hours [PoH]	SOC Operating Voltage	Arm Core Operating Voltage	Junction Temperature [T_j]
(MHz)	(Hrs)	(V)	(V)	(ºC)
1500	48,050	0.9	1.0	95
1500	21,900	0.9	1.05	95

Figure 1 establishes guidelines for estimating PoH as a function of junction temperature. PoH can be read directly from 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.

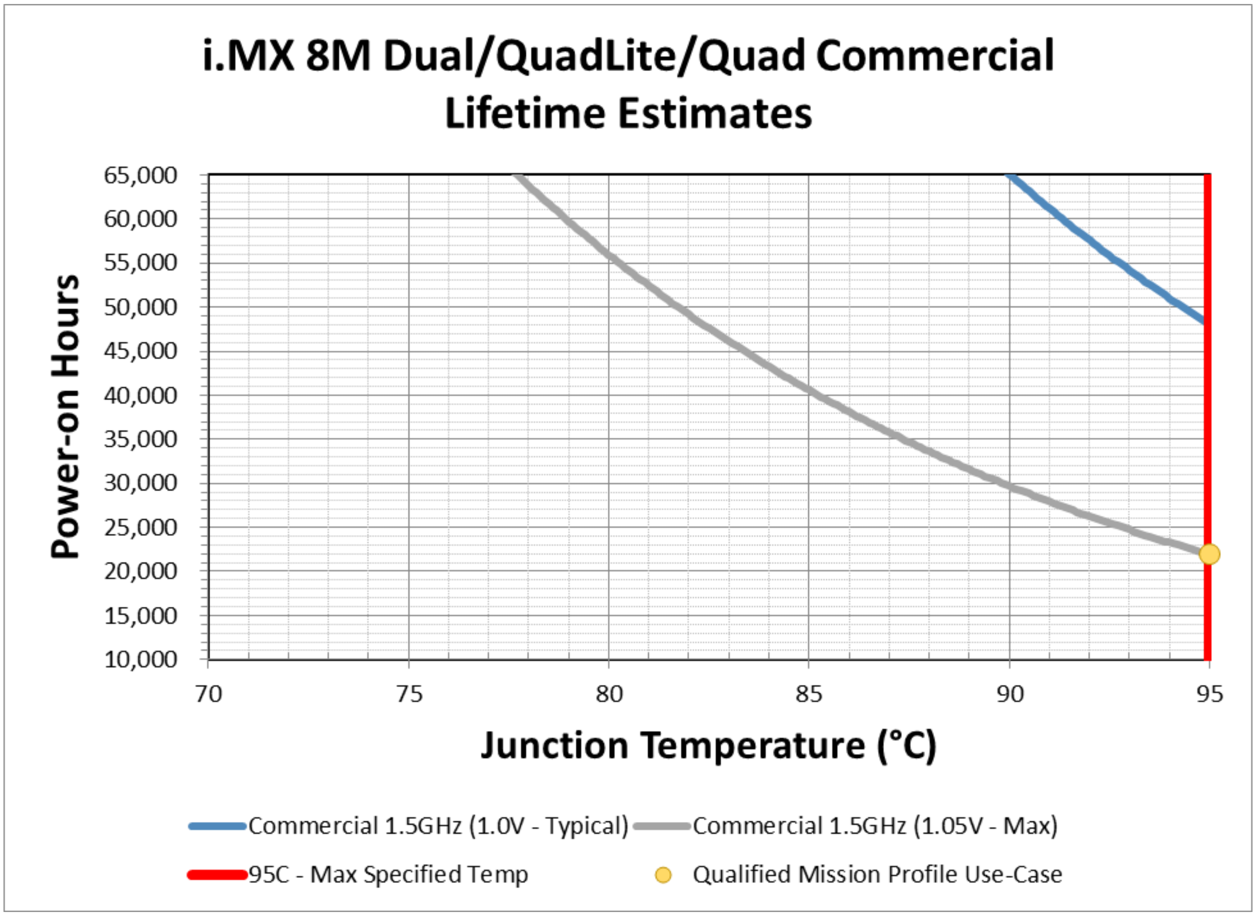

Figure 1. Commercial qualification lifetime estimates

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 Estimate

Arm Core Speed	Power-on Hours [PoH]	SOC Operating Voltage	Arm Core Operating Voltage	Junction Temperature [T_j]
(MHz)	(Hrs)	(V)	(V)	(ºC)
800	310,650	0.9	0.9	105
1300	64,630	0.9	1.0	105
1300	29,480	0.9	1.05	105

Figure 2 establishes guidelines for estimating PoH as a function of junction temperature. PoH can be read directly from 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.

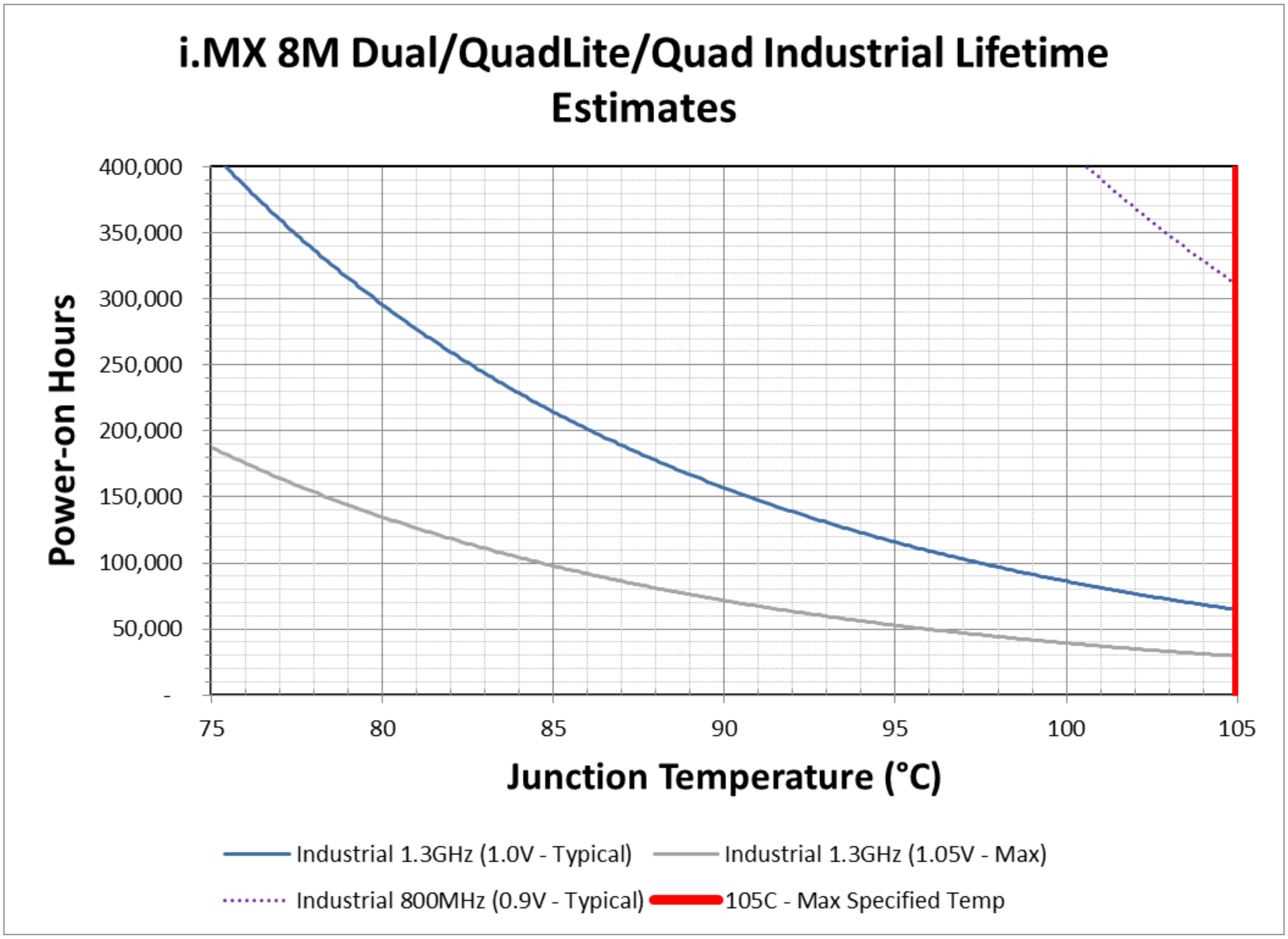

Figure 2. Industrial qualification lifetime estimates

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 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.

Use Case 1: Switching between two power states with different voltages.

In this use case, the system is using a 1.3GHz full power state at 1.05 V, and an 800 MHz reduced power state at 0.9 V. It is assumed for these calculations that the temperature stays constant in either mode. If the system spends 75 % of its power-on-time at full power and 25 % of its power-on-time at reduced power, the two POH (read from the chart below) can be combined with using those percentages: 29,480 x 0.75 + 310,650 x 0.25 = 99,770 PoH.

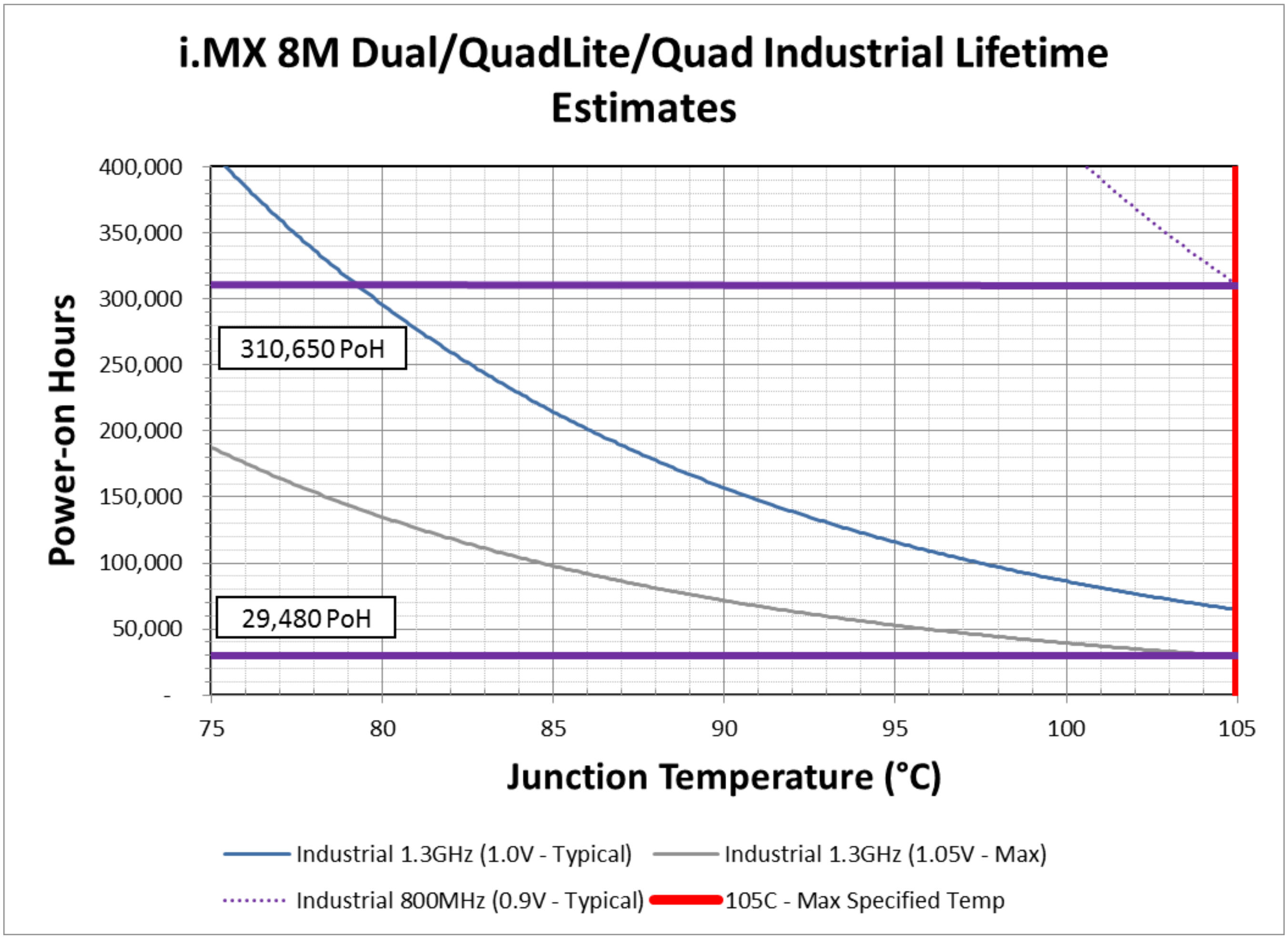

Figure 3. Multiple Power State Use Case

Use Case 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 achieved by changing the frequency or by simply scaling back the loading on the Arm core. In this scenario, the system spends 30 % of its power-on-hours at 80 C and 70 % of its power-on hours at 95 C (as read off the chart below). The two POH can be combined as such: 56,000 x 0.3 + 21,900 x 0.7 = 32,130 PoH.

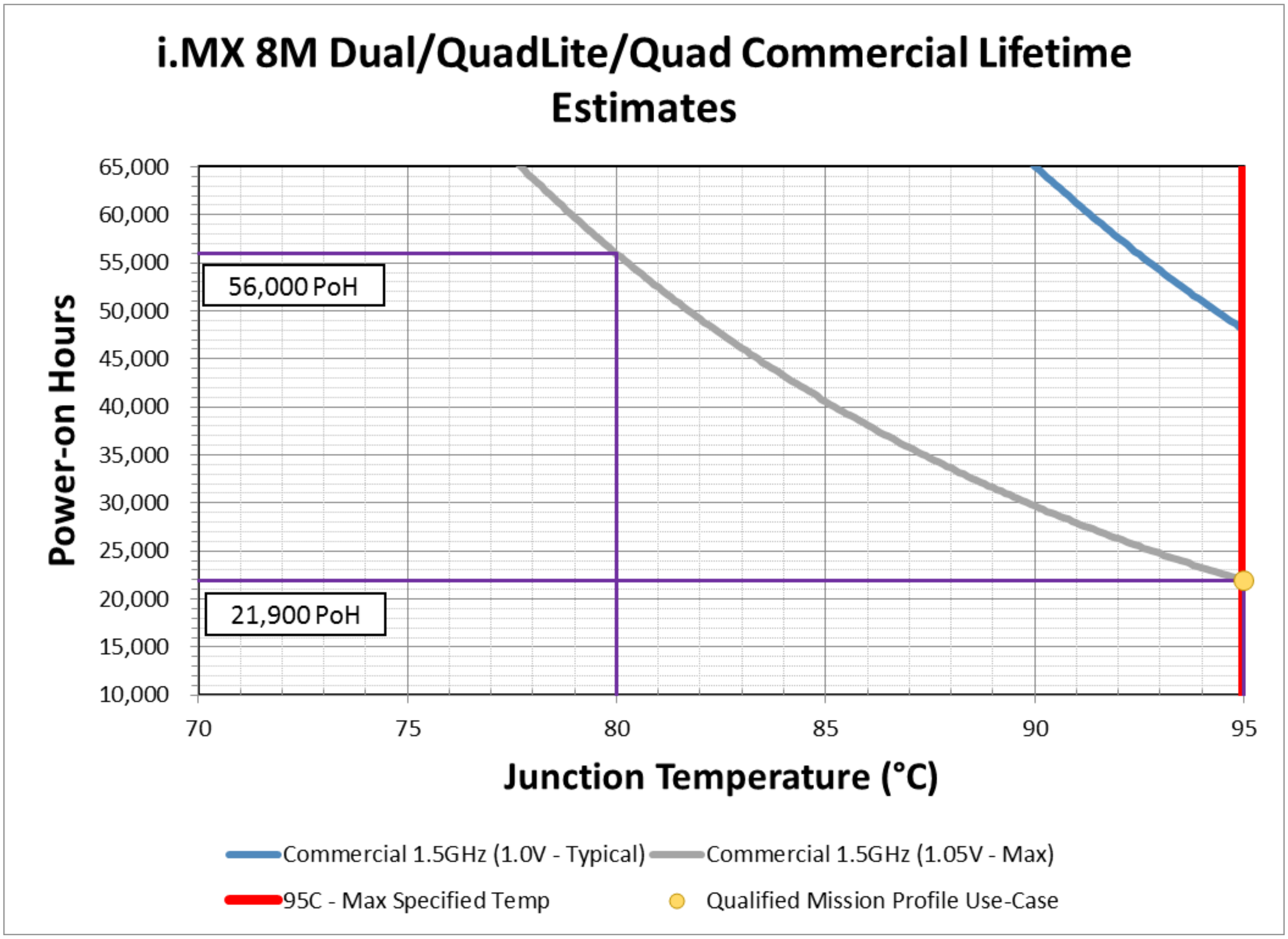

Figure 4. Multiple Temperature Use Case

4. Conclusion

Selecting the optimal operating performance point and thermal envelope is a paramount to meet the application lifetime targets. Trade-offs between the target operating voltage/frequency of the device and the operating junction temperature (Tj) of the processor can greatly improve the lifetime of the device.

Lowering the operating junction temperature in the application is the most effective means to increase the lifetime of the device without affecting the performance of the device. This can be accomplished by increasing the thermal dissipation capacity in the application. In cases where the thermal properties cannot be altered, a lower operating voltage can be used to increase the lifetime of the device. Lowering the voltage may result in lowered performance; the operating frequency may have to be adjusted lower to match the voltage as specified in the datasheet.

The data and examples provided in this application note help users determine the estimated lifetime for their particular application.

5. Revision history

Table 3. Revision history

Revision number	Date	Substantive changes
0	02/2018	Initial release

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