

i.MX 6ULL Product Usage Lifetime Estimates

1. Introduction

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

The product lifetimes described in this document are estimates and do not represent the guaranteed lifetime of 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 provides guidance on interpreting the i.MX 6ULL qualification levels in terms of the target operating frequency of the device, the maximum supported junction temperature of the processor (T_j), and how this relates to the lifetime of a device.

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

- The target frequency of the application (consumer, industrial).
 - The target frequency is determined by the input voltage of the processor's core complex (VDD_SOC_IN).
 - The use of the LDO-enabled or LDO-bypassed modes.
 - When using the LDO-bypassed mode, do not set the target voltage to the minimum specified in the datasheet. All power-management ICs have allowable tolerances. Set the target voltage higher than the minimum specified voltage to account for the tolerance of the PMIC.
 - The LDO-enabled mode uses the regulators on the i.MX 6ULL. These regulators are well-characterized and you may set them to output an exact minimum specified voltage. To achieve a higher PoH, use the LDO-enabled mode.
 - 800 MHz and 900 MHz can only be achieved in the LDO-enabled mode.
- The percentage of the active use compared to the standby.
 - The active use means that the processor is running in the active performance mode.
 - For the commercial tier, the performance modes are 528 MHz and 900 MHz.
 - For the industrial tier, the performance modes are 528 MHz and 800 MHz.
 - In the stand-by/DSM mode, the datasheet defines the lower operating conditions for the VDD_SOC_IN, reducing the power consumption and the 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 was powered off.
- The junction temperature of the processor (T_j).
 - The maximum junction temperature of the device is different for each tier of the product, for example, 95 °C for the commercial tier and 105 °C for the industrial tier. This maximum temperature is guaranteed by the final test.
 - Ensure that your device is appropriately thermally managed and the maximum junction temperature is not exceeded.

NOTE

All data provided within this document are estimates of the PoH, based on extensive qualification experience and testing with the i.MX 6 series. Do not view these statistically-derived estimates as a limit to the individual device's lifetime, nor construe them a warranty for the actual lifetime of a device. The sales and warranty terms and conditions still apply.

2. Device qualification level and available PoH definitions

2.1. Commercial qualification

This table provides the number of PoH for the typical use conditions of the extended commercial devices:

Table 1. Commercial qualification lifetime estimates

—	ARM® core frequency (MHz)	PoH (hours)	ARM core operating voltage (V)	Junction temperature [Tj] (°C)
Case C1: LDO enabled	528	21,900	1.15	95
Case C2: LDO bypassed	528	16,300	1.18	95
Case C3: LDO enabled	900	21,900	1.25	95

The following figures provide guidelines for estimating the PoH as a function of the CPU frequency and the junction temperature. Read the PoH directly from the charts below to determine the trade-offs to be made to the CPU frequency and the junction temperature to increase the estimated PoH of the device.

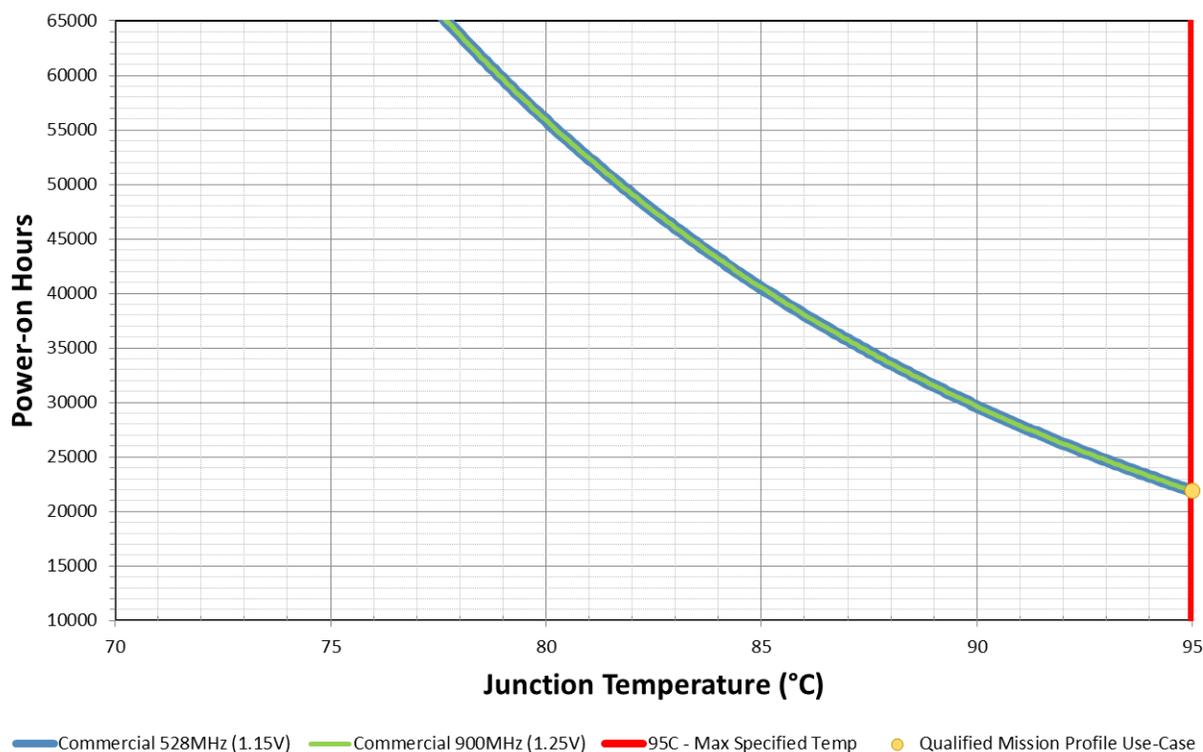


Figure 1. i.MX 6ULL commercial lifetime estimates in LDO-enabled mode

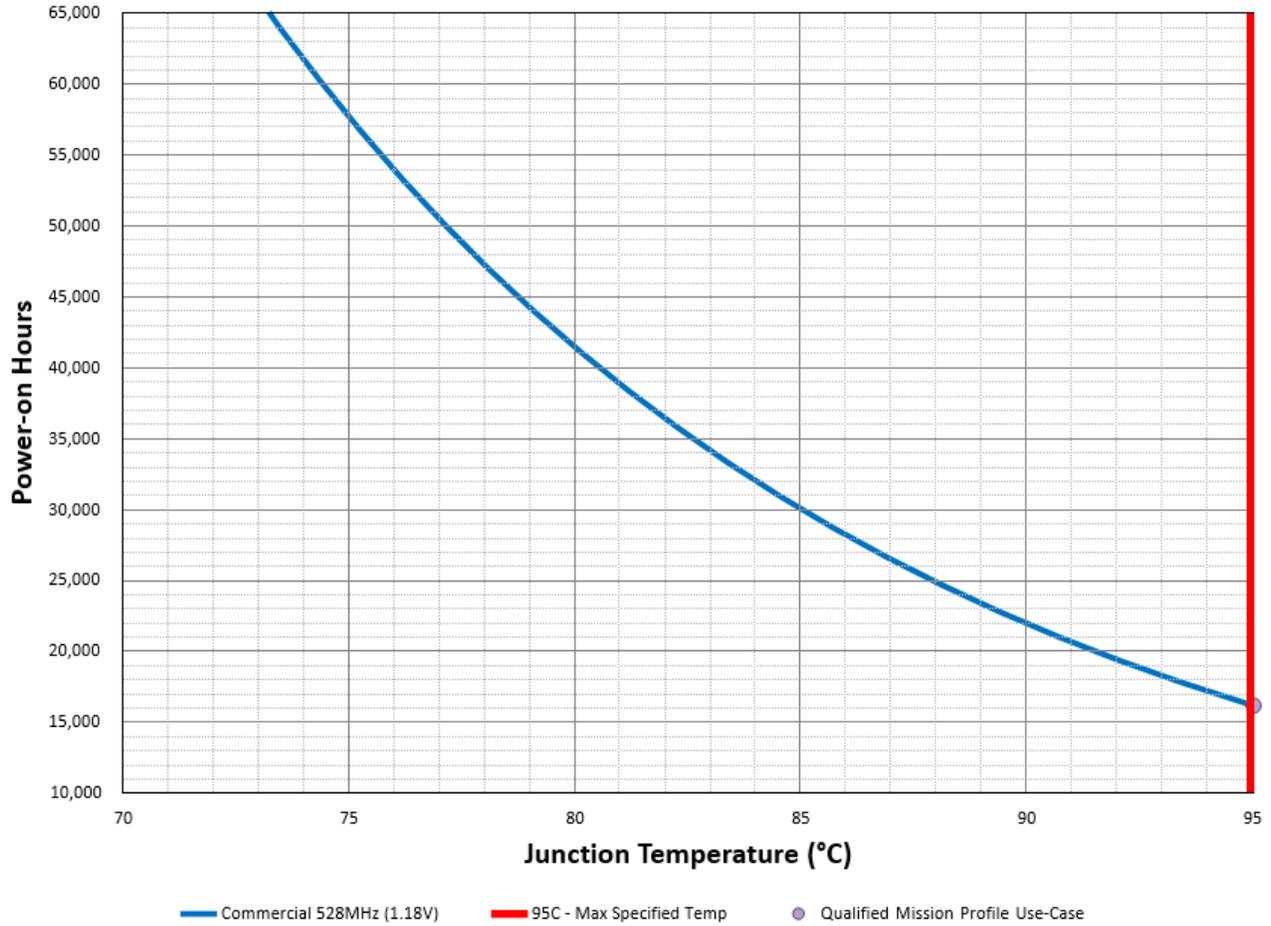


Figure 2. i.MX 6ULL commercial lifetime estimates in LDO-bypassed mode

2.2. Industrial qualification

This table provides the number of PoH for the typical use conditions of the industrial devices:

Table 2. Industrial qualification lifetime estimates

—	ARM core frequency (MHz)	PoH (hours)	ARM core operating voltage (V)	Junction temperature [Tj] (°C)
Case I1: LDO enabled	528	100,000	1.15	105
Case I2: LDO bypassed	528	64,261	1.18	105
Case I3: LDO enabled	800	87,689	1.2	105

The following figures provide guidelines to estimate the PoH as a function of the CPU frequency and the junction temperature. Read the PoH directly from the charts below to determine the trade-offs to be made to the CPU frequency and the junction temperature to increase the estimated PoH of the device.

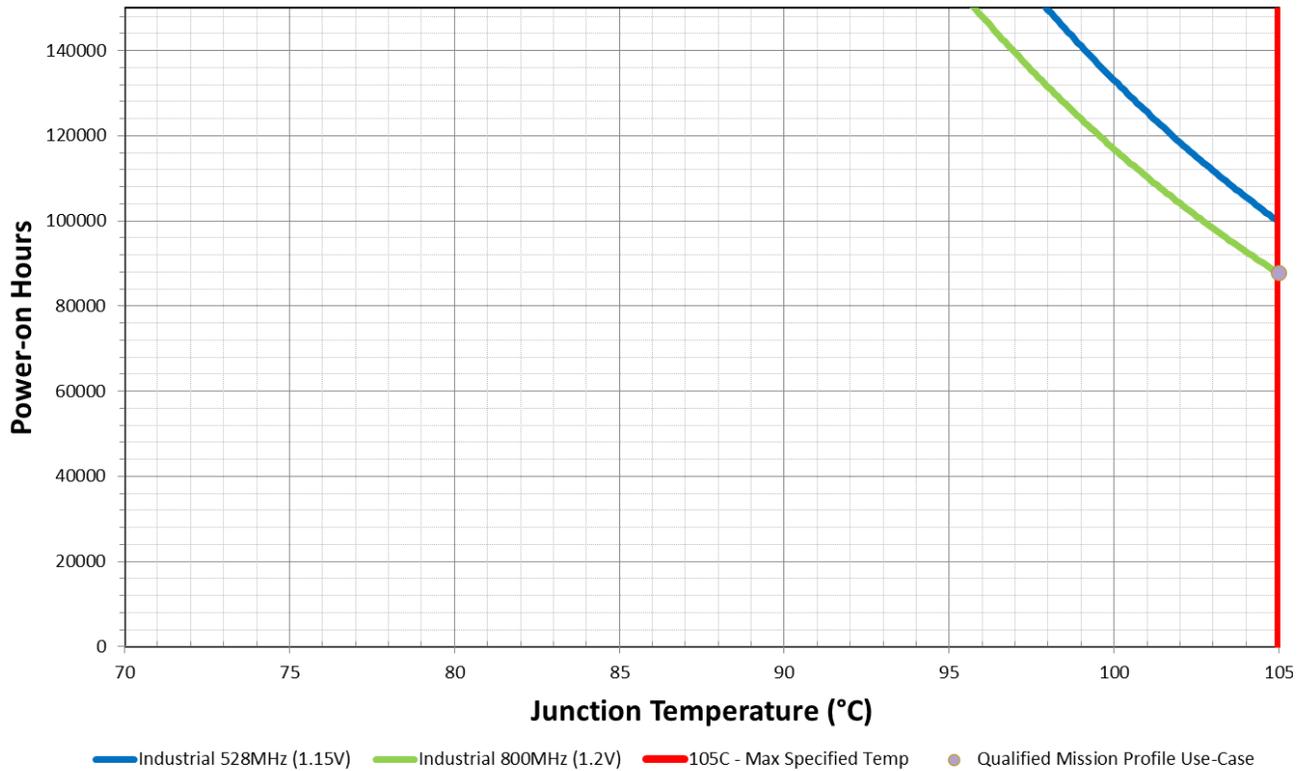


Figure 3. i.MX 6ULL industrial lifetime estimates in LDO-enabled mode

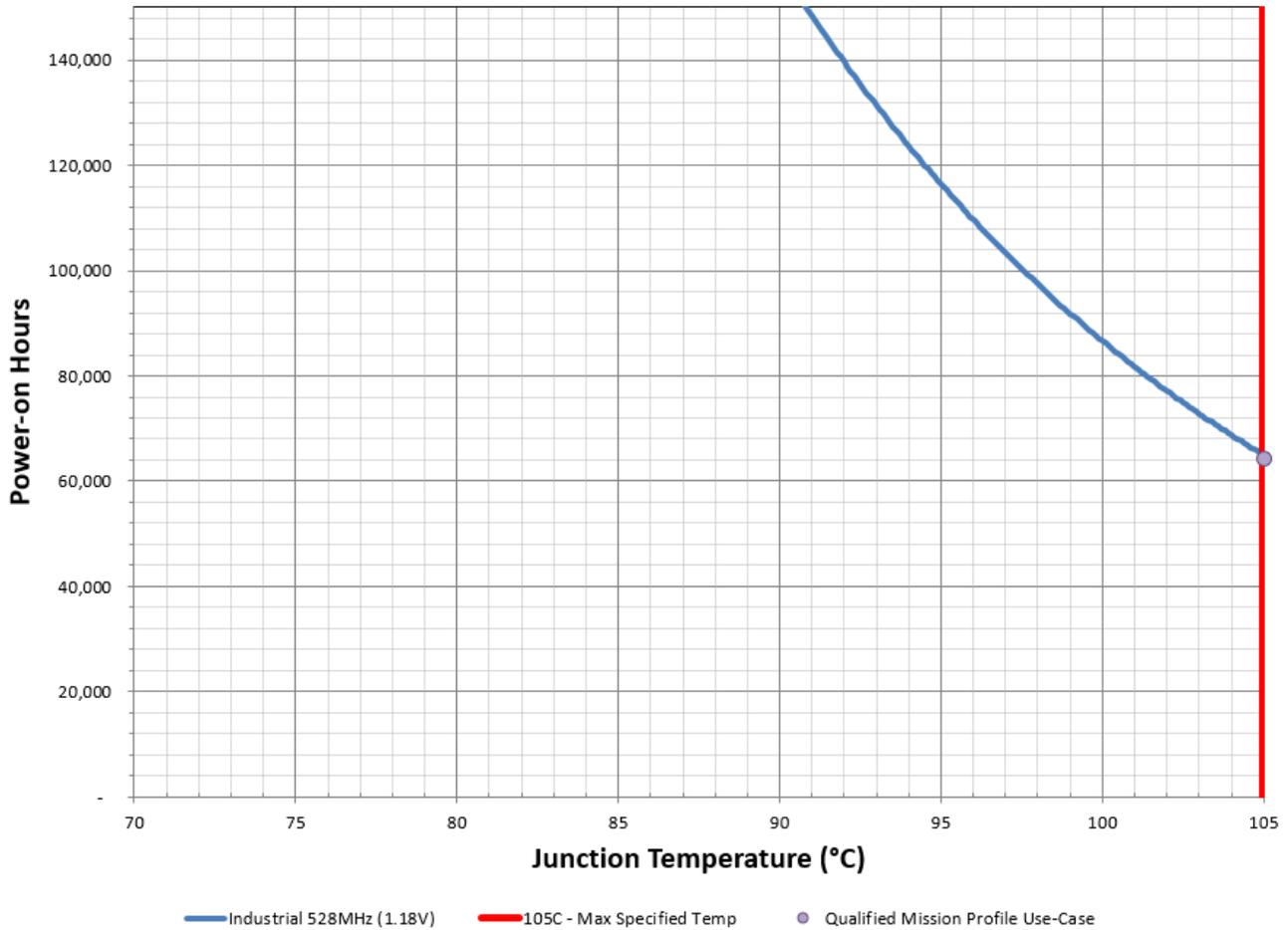


Figure 4. i.MX 6ULL industrial lifetime estimates in LDO-bypassed mode

3. Combining use cases

In some applications, a constant operating use case cannot provide the target PoH. In this case, multiple operating conditions are used. This method provides some of the benefits of running at a lower performance, while keeping the system’s ability to use the highest performance state required by the application.

3.1. Switching between two power states with different temperatures

This scenario assumes that the system can achieve a drop in the temperature by throttling back the performance, while still maintaining a constant voltage. Achieve this temperature change by changing the frequency, or by simply scaling back the load on the ARM cores and processing units. This use case is particularly useful if you want to take advantage of the full commercial temperature range of the i.MX 6ULL. In this scenario, the system spends 30 % of its PoH at 95 °C, 30 % of its PoH at 90 °C, and 40 % of its PoH at 85 °C (as shown in the following figure). Combine the three PoH values as:

$$21,900 \times 0.3 + 29,655 \times 0.3 + 40,529 \times 0.4 = 31,678 \text{ PoH} \tag{Eq. 1}$$

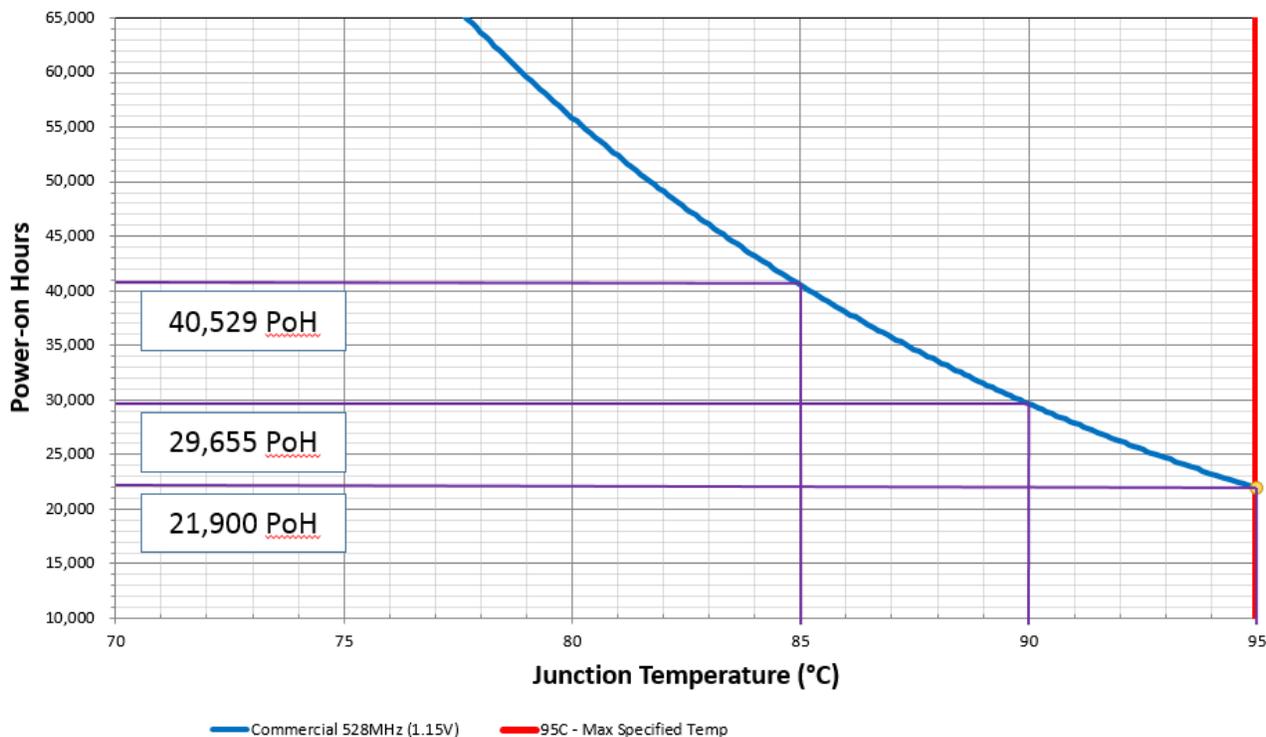


Figure 5. Multiple temperature use case

3.2. Switching between two power states with different voltages

In this scenario, the system is using the 800-MHz full-power state and the 528-MHz reduced-power state. For these calculations, it is assumed that the temperature stays constant in either mode. If the system spends 50 % of its PoH at 800 MHz and 50 % of its PoH at 528 MHz, combine the two PoH values (as shown in Figure 6) with the percentages:

$$116,866 \times 0.5 + 133,334 \times 0.5 = 125,100 \text{ PoH} \tag{Eq. 2}$$

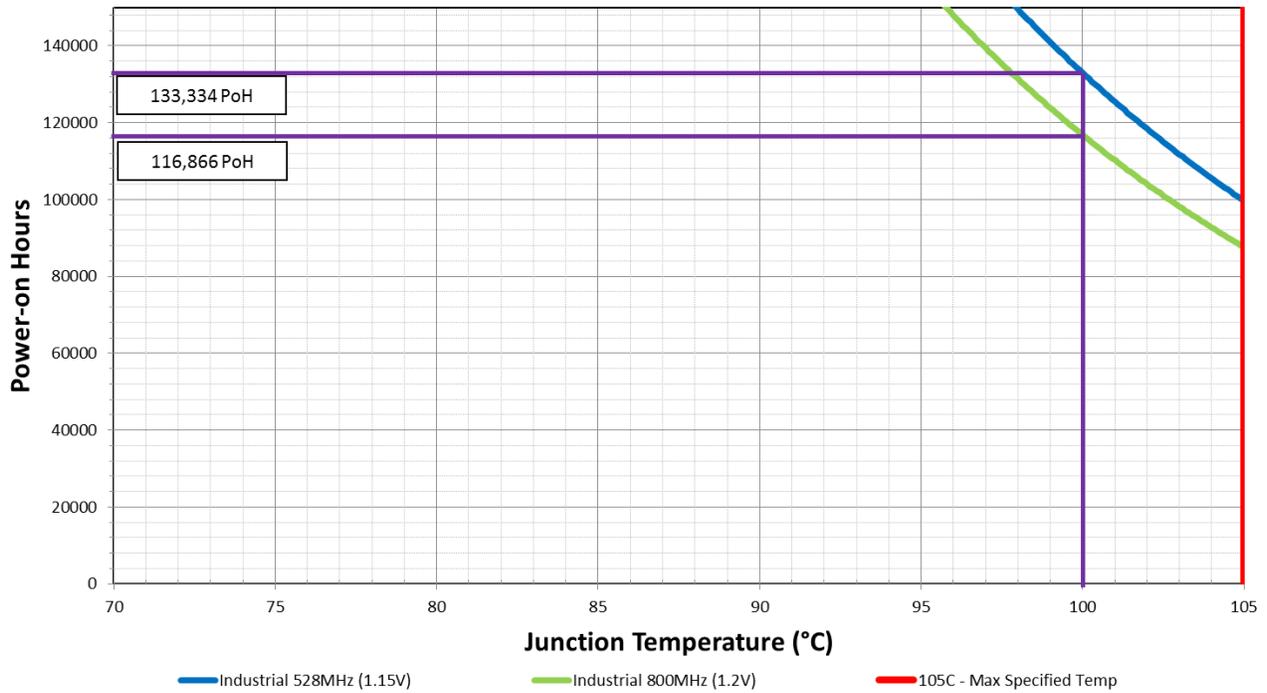


Figure 6. Multiple power state use case

4. Revision history

This table summarizes the changes made to this document since the initial release:

Table 3. Revision history

Revision number	Date	Substantive changes
0	09/2016	Initial release.
1	03/2017	Updated figures. Added Section 3.2, "Switching between two power states with different voltages" .

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