Application Note

Astra™ SL1640 Product Lifetime

Abstract: This document outlines the estimated product lifetime of the Astra™ SL1640.

  | PN: 506-001583-01 Rev A .

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1. Introduction

This document outlines the estimated product lifetime of the Astra™ SL1640, based on the criteria from the qualification process. It aims to help users understand the various SL1640 qualification levels concerning the device's target operating frequencies, the maximum supported junction temperature (Tj) of the processor, and their implications for the device's lifespan.

The product lifetime provided are estimates and do not constitute a guaranteed lifespan for the product.

2. Device Qualification Level and Available Power-on Hours (PoH)

1. The product's lifetime is directly dependent on the voltage and temperature.
2. The junction temperature of the processor (Tj).
    a. The maximum junction temperature of the device is 105°C for consumer and 125°C for Industrial.
    b. Users must make sure their device is adequately thermally managed to prevent exceeding the maximum junction temperature.

    All data provided in this document are Power-on Hours (PoH) estimates based on extensive qualification experience and testing with the Astra™ SL1640. These statistically derived estimates are not intended to define the product lifetime limit of any individual device, nor should they be interpreted as a guarantee from Synaptics regarding the actual lifespan of the device.
3. Terminology used in this document:
    - **VCPU:** Voltage supply for the Central Processing Unit (CPU) of the device.
    - **VCORE:** Voltage supply for the CORE of the device.
    - **VL:** Low voltage of the operating range power supply for the device.
    - **VH:** High voltage of the operating range power supply for the device.

The device operates within two voltage ranges, depending on the CPU frequency and the leakage characteristics of the device:

- **Typical operating voltage range:** The typical range from VL to VH (see chart legend for detailed values).
- **Maximum operating voltage range:** The maximum allowable range from VL to VH (see chart legend for detailed values).

3. Consumer Product Lifetime Estimates

3.1. Consumer SL1640 Product Lifetime at Tj = 105°C for VL

VCPU LOW Max (VL) = Max VL (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 1. Consumer VCPU Max VL = 0.900V (+IRdrop 25mV), CPU 1.8GHz, Tj=105°C

CPU Speed	SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(GHz)	(V)	(°C)	Hours	Years
1.8	0.925	105	266,282	30.4

VCPU LOW Typ. (VL) = Typ. VL (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 2. Consumer VCPU Typ. VL = 0.8125V (+IRdrop 25mV), CPU 1.8GHz, Tj=105°C

CPU Speed	SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(GHz)	(V)	(°C)	Hours	Years
1.8	0.8375	105	1,178,570	134.5

VCORE LOW Max (VL) = Max VL (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 3. Consumer VCORE Max. VL = 0.8875V (+IRdrop 25mV), DDR4 3200Mbps, NPU/TSP 700MHz, GPU/V4G/DSP 800MHz, Tj=105°C

SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(V)	(°C)	Hours	Years
0.9125	105	329,329	37.5

VCORE LOW Typ. (VL) = Typ. VL (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 4. Consumer VCORE Typ. VL = 0.7875V (+IRdrop 25mV), DDR4 3200Mbps, NPU/TSP 700MHz, GPU/V4G/DSP 800MHz, Tj=105°C

SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(V)	(°C)	Hours	Years
0.8125	105	1,802,730	205.7

3.2. Consumer SL1640 Product Lifetime at Tj = 105°C for VH

VCPU HIGH Max (VH) = Max VH (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 5. Consumer VCPU Max VH = 0.975V (+IRdrop 25mV), CPU 2GHz, Tj=105°C

CPU Speed	SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(GHz)	(V)	(°C)	Hours	Years
2	1	105	74,407	8.5

VCPU HIGH Typ. (VH) = Typ. VH (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 6. Consumer VCPU Typ. VH = 0.875V (+IRdrop 25mV), CPU 2GHz, Tj=105°C

CPU Speed	SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(GHz)	(V)	(°C)	Hours	Years
2	0.900	105	407,303	46.5

VCORE HIGH Max (VH) = Max. VH (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 7. Consumer VCORE Max VH = 0.900V (+IRdrop 25mV), DDR4 3200Mbps, NPU/TSP 800MHz, GPU/V4G/DSP 900MHz, Tj=105°C

SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(V)	(°C)	Hours	Years
0.925	105	266,282	30.4

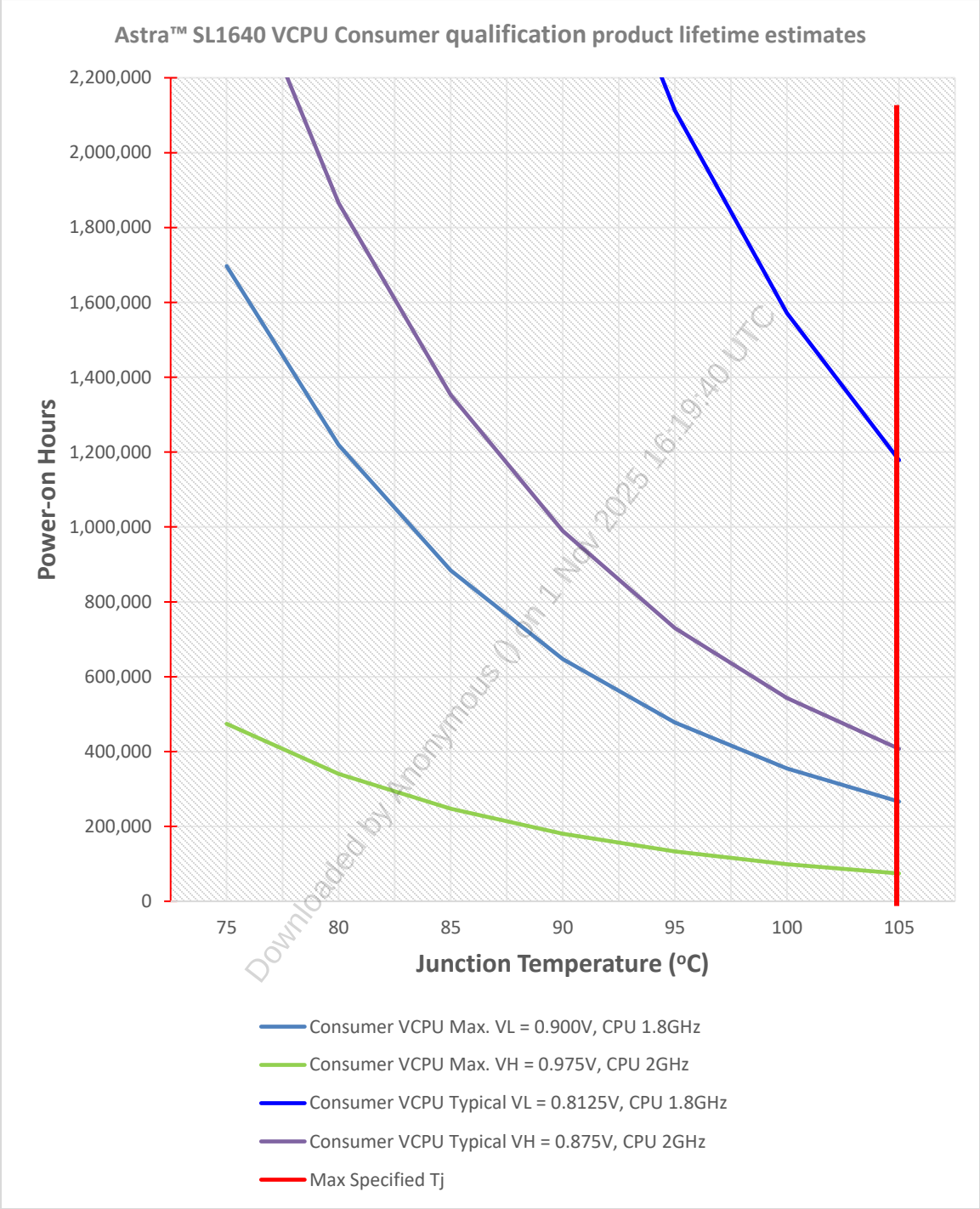
VCORE HIGH Typ. (VH) = Max. VH (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 8. Consumer VCORE Typ. VH = 0.825V (+IRdrop 25mV), DDR4 3200Mbps, NPU/TSP 800MHz, GPU/V4G/DSP 900MHz, Tj=105°C

SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(V)	(°C)	Hours	Years
0.850	105	952,945	108.8

PoH can be directly retrieved from

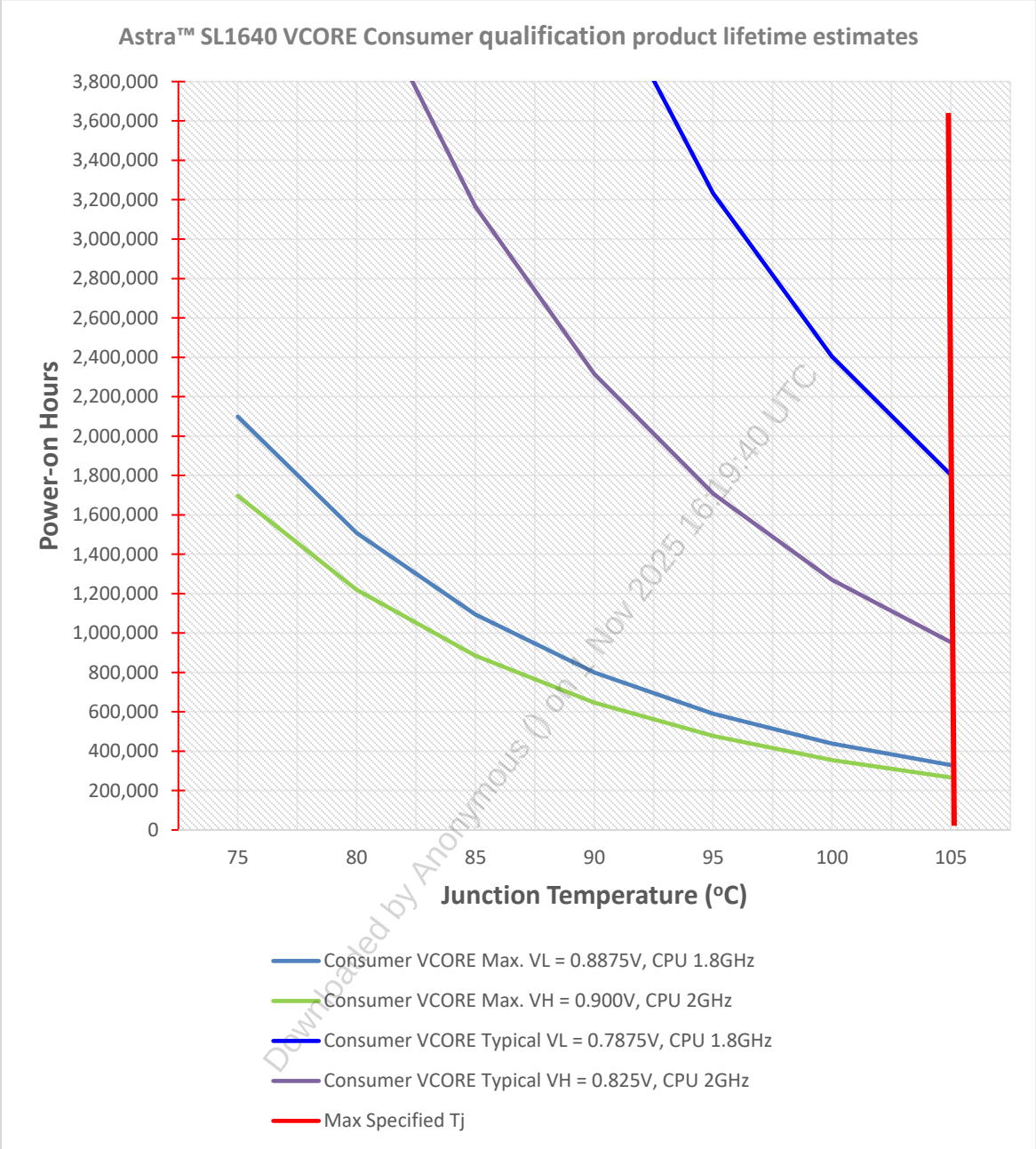
Figure 1 to determine the necessary trade-offs between CPU frequency and junction temperature in order to extend the estimated PoH of the device.



Note: The plot includes IRdrop 25mV.

Figure 1. Astra SL1640 VCPU Consumer qualification product lifetime estimates

PoH can be directly retrieved from Figure 2 to determine the necessary trade-offs between CPU frequency and junction temperature in order to extend the estimated PoH of the device.



Note: The plot includes IRdrop 25mV.

Figure 2. Astra SL1640 VCORE Consumer qualification product lifetime estimates

4. Industrial Product Lifetime Estimates

4.1. Industrial SL1640 Product Lifetime at Tj = 105°C for VL

VCPU LOW Max (VL) = Max VL (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 9. Industrial VCPU Max VL = 0.925V (+IRdrop 25mV), CPU 1.8GHz, Tj=105°C

CPU Speed	SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(GHz)	(V)	(°C)	Hours	Years
1.8	0.950	105	348,174	39.7

VCPU LOW Typ. (VL) = Typ. VL (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 10. Industrial VCPU Typ. VL = 0.8375V (+IRdrop 25mV), CPU 1.8GHz, Tj=105°C

CPU Speed	SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(GHz)	(V)	(°C)	Hours	Years
1.8	0.8625	105	1,541,027	176

VCORE LOW Max (VL) = Max VL (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 11. Industrial VCORE Max VL = 0.925V (+IRdrop 25mV), DDR4 3200Mbps, NPU/TSP 700MHz, GPU/V4G/DSP 800MHz, Tj=105°C

SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(V)	(°C)	Hours	Years
0.950	105	348,174	40

VCORE LOW Typ. (VL) = Typ. VL (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 12. Industrial VCORE Typ. VL =0.825V (+IRdrop 25mV), DDR4 3200Mbps, NPU/TSP 700MHz, GPU/V4G/DSP 800MHz, Tj=105°C

SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(V)	(°C)	Hours	Years
0.850	105	1,905,891	217.5

4.2. Industrial SL1640 Product Lifetime at T_j = 105°C for VH

VCPU HIGH Max (VH) = Max VH (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 13. Industrial VCPU Max VH = 1.000V (+IRdrop 25mV), CPU 2GHz, Tj=105°C

CPU Speed	SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(GHz)	(V)	(°C)	Hours	Years
2	1.025	105	97,290	11

VCPU HIGH Typ. (VH) = Typ. VH (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 14. Industrial VCPU Typ. VH = 0.900V (+IRdrop 25mV), CPU 2GHz, Tj=105°C

CPU Speed	SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(GHz)	(V)	(°C)	Hours	Years
2	0.925	105	532,565	60.8

VCORE HIGH Max (VH) = Max. VH (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 15. Industrial Max VH = 0.9375V (+IRdrop 25mV), DDR4 3200Mbps, NPU/TSP 800MHz, GPU/V4G/DSP 900MHz, Tj=105°C

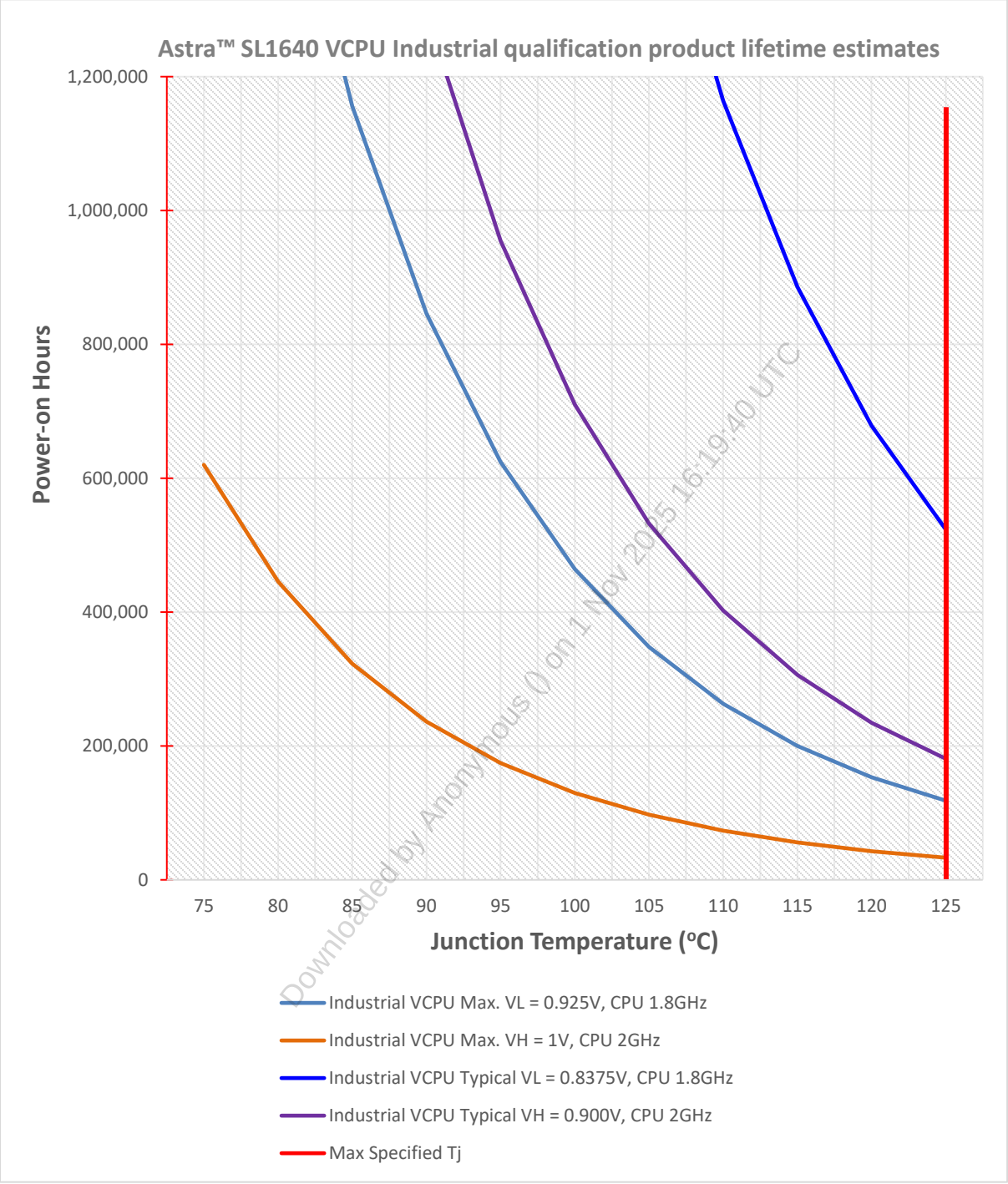
SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(V)	(°C)	Hours	Years
0.9625	105	281,520	32

VCORE HIGH Typ. (VH) = Max. VH (+IRdrop 25mV), Product Lifetime @Tj=105°C

Table 16. Industrial Typ. VH = 0.8625V (+IRdrop 25mV), CPU 2GHz, DDR4 3200Mbps, NPU/TSP 800MHz, GPU/V4G/DSP 900MHz, Tj=105°C

SoC Operating Voltage	Junction Temperature Tj	Power-on Hours (PoH)	Product Lifetime
(V)	(°C)	Hours	Years
0.8875	105	1,007,477	115

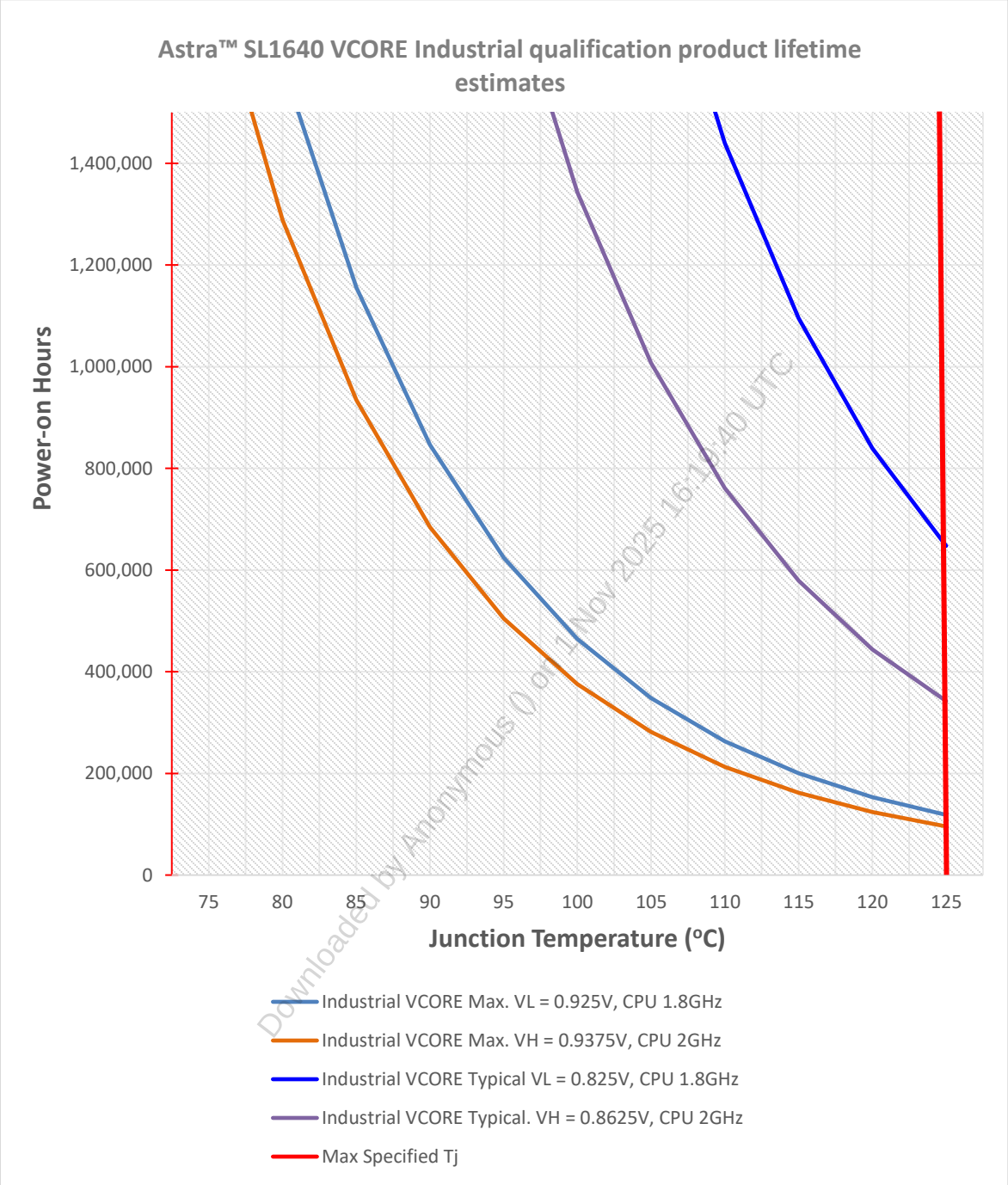
PoH can be directly retrieved from Figure 3 to determine the necessary trade-offs between CPU frequency and junction temperature in order to extend the estimated PoH of the device.



Note: The plot includes IRdrop 25mV.

Figure 3. Astra SL1640 VCPU Industrial qualification product lifetime estimates

PoH can be directly retrieved from Figure 4 to determine the necessary trade-offs between CPU frequency and junction temperature in order to extend the estimated PoH of the device.



Note: The plot includes IDrop 25mV.

Figure 4. Astra SL1640 VCORE Industrial qualification product lifetime estimates

5. Summary

Balancing the target operating voltage and frequency of the device with the processor's junction temperature (Tj) can significantly extend the device's lifespan.

Reducing the operating junction temperature is the most effective way to increase the device's product lifetime without impacting performance. This can be achieved by enhancing the application's thermal dissipation capacity.

Additionally, the junction temperature can be monitored, and performance can be adjusted to prevent it from exceeding the maximum allowable level.

6. References

- *SL1640 Embedded IoT Processor Electrical Specification Datasheet* (PN: 505-001415-01)

7. Revision History

Revision	Description
A	Initial release

PN: 506-001583-01 Rev A