



Temperature Excursion Usage Guide for Lattice Devices

Technical Note

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1. Introduction

Semiconductor manufacturers specify a device lifetime through an accelerated life test, which measures how long a device runs at a selected temperature before it fails. Typically, devices are expected to operate within this specified temperature range. Temperature excursion, as defined in this Technical Note, allows for the device to operate outside the specified temperature range for a specified maximum duration.

Lattice families of devices typically come in three grades: commercial, industrial, and automotive. The Lattice industrial grade devices support a junction temperature range of $-40\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$. The list of devices in this Technical Note support an excursion of $10\text{ }^{\circ}\text{C}$ above the maximum temperature listed in the respective data sheets.

2. Temperature Excursion Supported Devices

The devices listed in [Table 2.1](#) support temperature excursions of $10\text{ }^{\circ}\text{C}$ up to a maximum junction temperature of $110\text{ }^{\circ}\text{C}$. The devices have been verified to operate in this extended temperature range and still meet the lifetime specification of the device.

Designs that need to support temperature excursion should include an additional 1% of timing margin through Lattice Diamond® Software. PAR_ADJ (keyword) can be used in PERIOD and FREQUENCY timing constraint to overconstrain the design ([Figure 2.1](#)). See [Lattice Diamond 3.12 User Guide](#) for details. The user guide can also be downloaded from the Lattice Diamond software [Start Page](#) under [Help > Lattice Diamond Help](#).

Table 2.1. Devices Supporting Temperature Excursion

Device Family	Speed	Grade	Excursion Temperature Range	Excursion Duration	Condition
LCMX03L	-5	Industrial ($-40\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$)	$100\text{ }^{\circ}\text{C}$ to $110\text{ }^{\circ}\text{C}$	10% of lifetime (8,760 consecutive or accumulative hours)	Add additional 1% timing margin
	-6		$100\text{ }^{\circ}\text{C}$ to $110\text{ }^{\circ}\text{C}$		
LCMX03LF	-5		$100\text{ }^{\circ}\text{C}$ to $110\text{ }^{\circ}\text{C}$		
	-6		$100\text{ }^{\circ}\text{C}$ to $110\text{ }^{\circ}\text{C}$		
LCMX03D*	-2		$100\text{ }^{\circ}\text{C}$ to $110\text{ }^{\circ}\text{C}$		
	-3		$100\text{ }^{\circ}\text{C}$ to $110\text{ }^{\circ}\text{C}$		
	-5		$100\text{ }^{\circ}\text{C}$ to $110\text{ }^{\circ}\text{C}$		
	-6		$100\text{ }^{\circ}\text{C}$ to $110\text{ }^{\circ}\text{C}$		

*Note: Not applicable for LCMX03D in 69-ball WLCSP

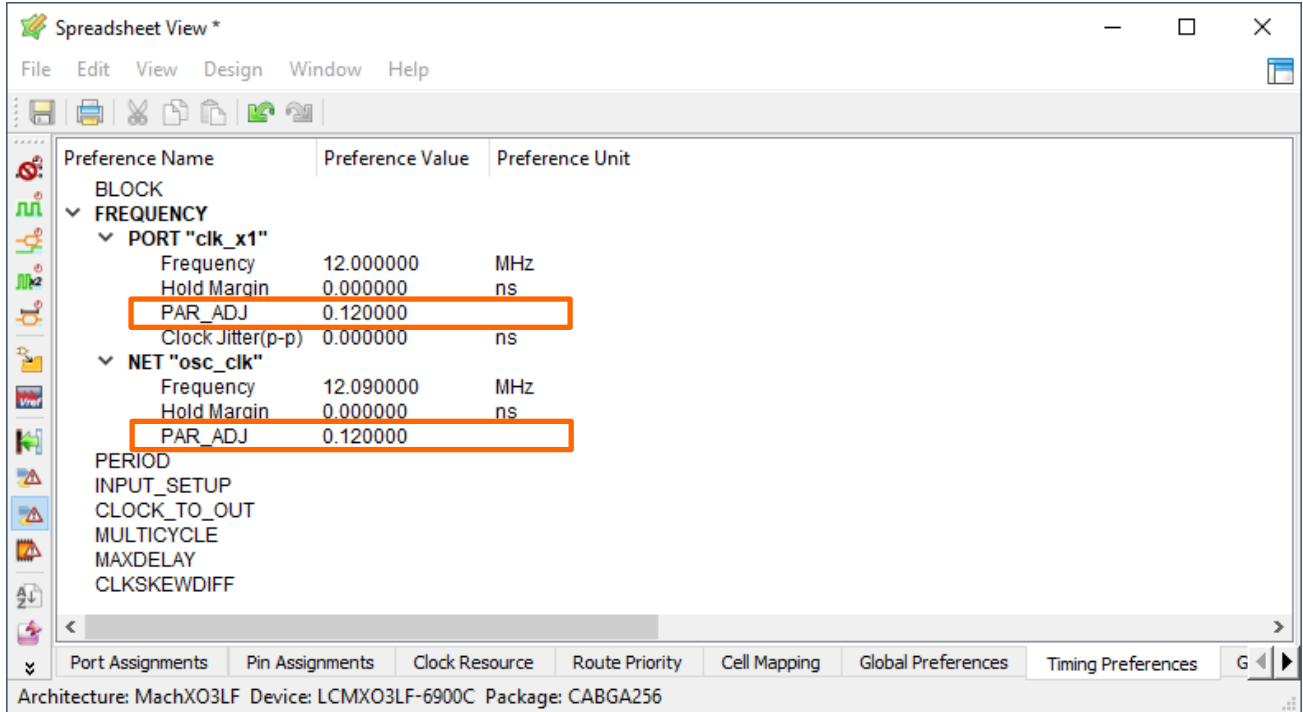


Figure 2.1. Diamond Software Spreadsheet View – Timing Preferences Tab

3. Power Calculator

Power Calculator, which is part of Diamond software, is used to estimate the power dissipation for a given design. This same tool can also be used to obtain power estimation with temperature excursion. You should go through the standard flow to populate the necessary fields in Power Calculator to get the power consumption of the design, with no temperature excursion.

Once the baseline power consumption is obtained, the additional power from the temperature excursion can be acquired by selecting **Worst** for **Process Type** & by entering the ambient temperature that correlates to the temperature excursion of the design. The **Ambient Temperature** field in Power Calculator’s **Power Summary** tab (Figure 3.1) allows a range of $-40\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$. When the ambient temperature setting results in exceeding the data sheet maximum allowed junction temperature of the device, the **Junction Temperature** field turns red as a warning to the user. This can be ignored for temperature excursion case. Power Calculator updates the total power based on the specified junction temperature. Note that temperature excursion designs cannot exceed $110\text{ }^{\circ}\text{C}$ junction temperature even though Power Calculator allows an ambient temperature that results in a junction temperature above $110\text{ }^{\circ}\text{C}$.

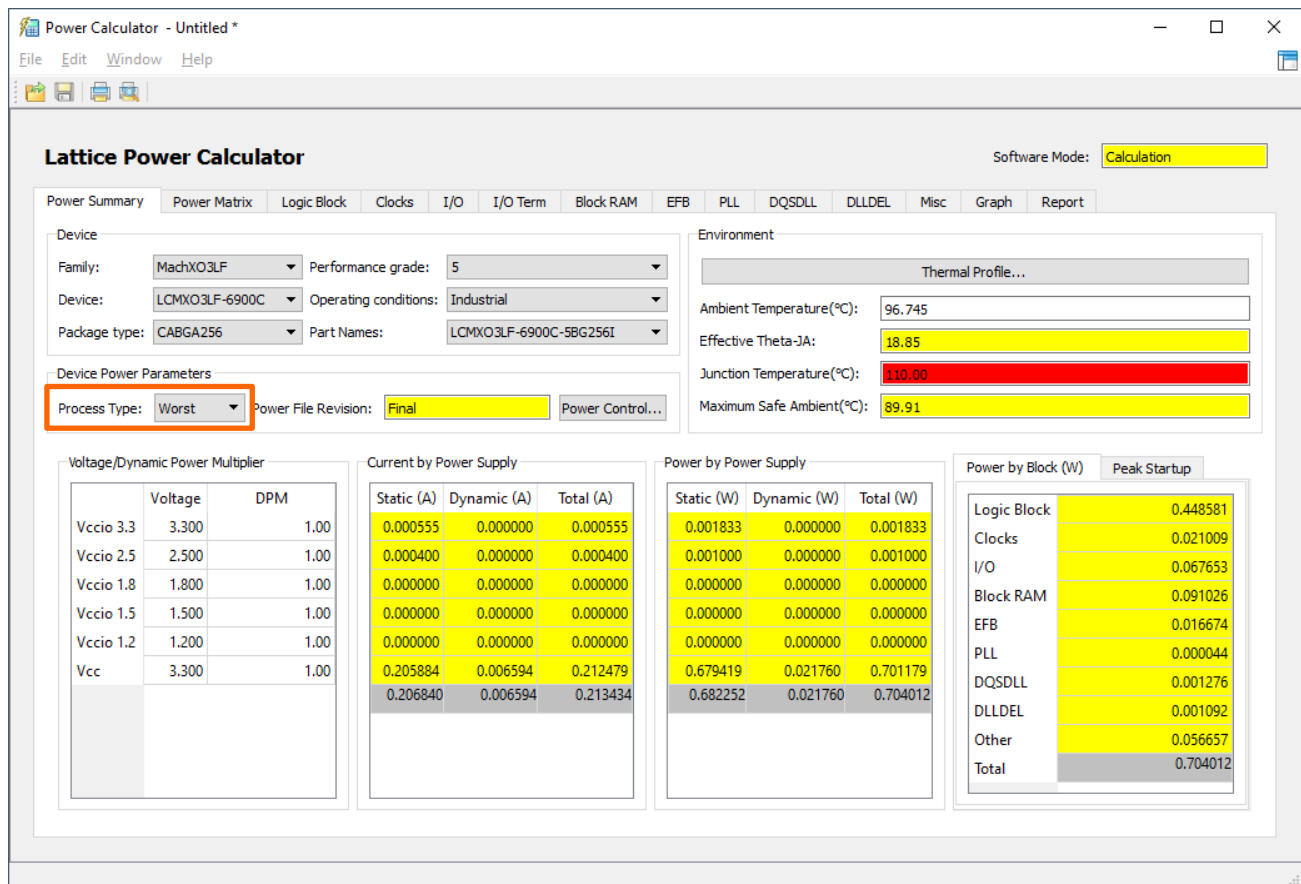


Figure 3.1. Power Calculator – Power Summary Tab

4. Summary

Temperature excursion allows for limited duration device operation above the specified temperature range. Lattice devices MachXO3L (LCMXO3L), MachXO3LF (LCMXO3LF), and MachXO3D (LCMXO3D) can support a temperature excursion of 10 °C above the data sheet maximum operating temperature. The only requirement for this temperature excursion support is to add 1% timing margin in the design through Diamond Software while assuring device junction temperatures do not exceed maximum operating temperature plus 10%. Lattice's Power Calculator tool can be used to provide power dissipation estimation during the temperature excursion with a simple update to the ambient temperature field of Power Calculator.

References

For more information, refer to the following documents:

- [MachXO3 Family Data Sheet \(FPGA-DS-02032\)](#)
- [MachXO3D Family Data Sheet \(FPGA-DS-02026\)](#)

Technical Support Assistance

Submit a technical support case through www.latticesemi.com/techsupport.

Revision History

Revision 1.1, October 2021

Section	Change Summary
Temperature Excursion Supported Devices	Added footnote to Table 2.1. Devices Supporting Temperature Excursion.

Revision 1.0, September 2021

Section	Change Summary
All	Production release.



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