



Temperature Excursion User Guide for MachXO3 and MachXO4 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.

The Lattice Semiconductor family of devices typically come in three grades: commercial, industrial, and automotive. The Lattice Semiconductor industrial grade devices support a junction temperature range of -40°C to 100°C . The list of devices in this Technical Note support an excursion of 10°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°C up to a maximum junction temperature of 110°C . The devices are 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 for MachXO3L, MachXO3LF, and MachXO3D devices. PAR_ADJ (keyword) can be used in PERIOD and FREQUENCY timing constraint to over constraint the design ([Figure 2.1](#)). See the latest Lattice Diamond User Guide in the [Lattice Diamond](#) web page for more details. The user guide can also be downloaded from the Lattice Diamond software *Start Page* under *Help > Lattice Diamond Help*.

Designs that need to support temperature excursion must include an additional 1% of timing margin through Lattice Radiant™ software for MachXO4 devices. Constraints can be set in Radiant to over constraint the design. See the latest Lattice Radiant User Guide in the [Lattice Radiant](#) web page for more details. The user guide can also be downloaded from the Lattice Radiant software *Start Page* under *Help > Lattice Radiant Software Help*.

Table 2.1. Devices Supporting Temperature Excursion

Device Family	Speed	Grade	Excursion Temperature Range	Excursion Duration	Condition
LCMXO3L	-5	Industrial (-40°C to 100°C)	100°C to 110°C	10% of lifetime (8,760 consecutive or accumulative hours)	Add additional 1% timing margin
	-6		100°C to 110°C		
LCMXO3LF	-5		100°C to 110°C		
	-6		100°C to 110°C		
LCMXO3D ¹	-2		100°C to 110°C		
	-3		100°C to 110°C		
	-5		100°C to 110°C		
	-6		100°C to 110°C		
LFMXO4	-5	Industrial (-40°C to 100°C)	100°C to 110°C	10% of lifetime (8,760 consecutive or accumulative hours)	Add additional 1% timing margin
	-6		100°C to 110°C		

Note:

1. Not applicable for LCMXO3D in 69-ball WLCSP.

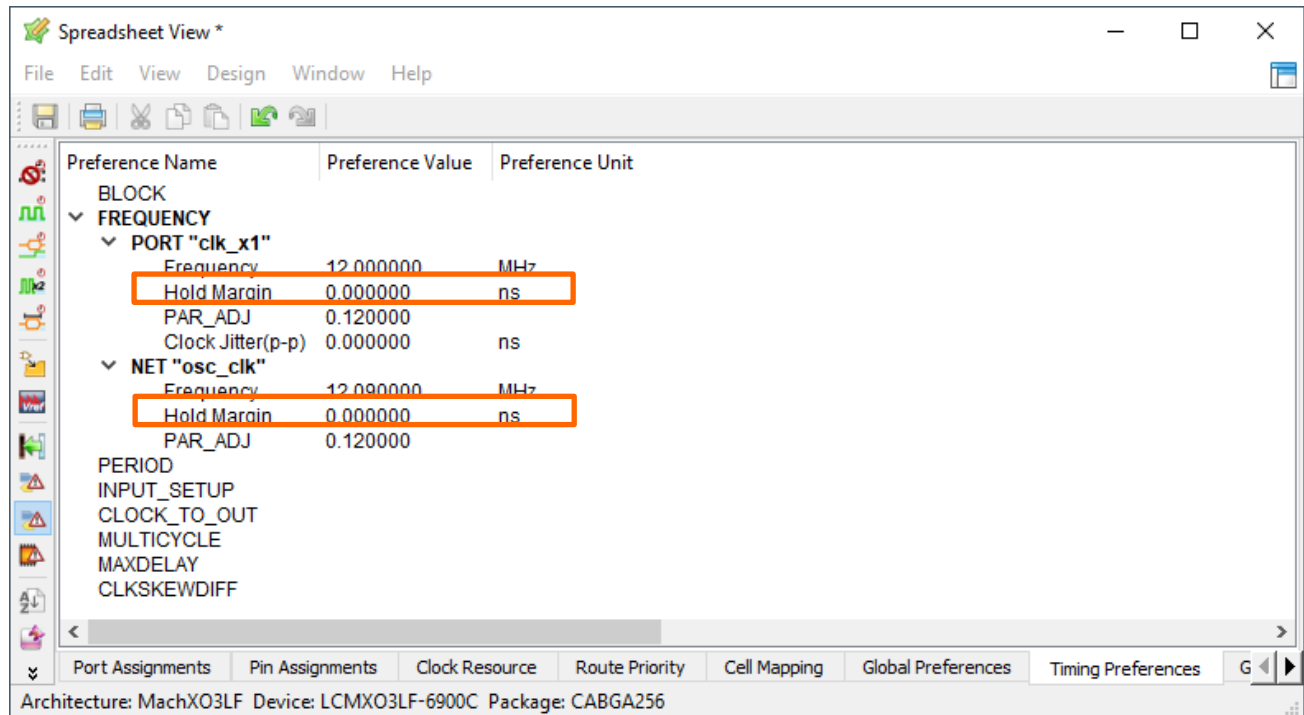


Figure 2.1. Diamond Software Spreadsheet View – Timing Preferences Tab

3. Power Calculator

Power Calculator, which is part of Diamond and Radiant 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 must 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* and 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 °C to 125 °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 you. 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 °C junction temperature even though Power Calculator allows an ambient temperature that results in a junction temperature above 110 °C.

Lattice Power Calculator Software Mode: **Calculation**

Power Summary | Power Matrix | Logic Block | Clocks | I/O | I/O Term | Block RAM | EFB | PLL | DQS DLL | DLL DEL | Misc | Graph | Report

Device
 Family: MachXO3LF Performance grade: 5
 Device: LCMXO3LF-6900C Operating conditions: Industrial
 Package type: CABGA256 Part Names: LCMXO3LF-6900C-SBG2561

Environment
 Thermal Profile...
 Ambient Temperature(°C): 96.745
 Effective Theta-JA: 18.85
 Junction Temperature(°C): 110.00
 Maximum Safe Ambient(°C): 89.91

Device Power Parameters
 Process Type: Worst Power File Revision: Final Power Control...

Voltage/Dynamic Power Multiplier		
	Voltage	DPM
Vccio 3.3	3.300	1.00
Vccio 2.5	2.500	1.00
Vccio 1.8	1.800	1.00
Vccio 1.5	1.500	1.00
Vccio 1.2	1.200	1.00
Vcc	3.300	1.00

Current by Power Supply		
Static (A)	Dynamic (A)	Total (A)
0.000555	0.000000	0.000555
0.000400	0.000000	0.000400
0.000000	0.000000	0.000000
0.000000	0.000000	0.000000
0.000000	0.000000	0.000000
0.205884	0.006594	0.212479
0.206840	0.006594	0.213434

Power by Power Supply		
Static (W)	Dynamic (W)	Total (W)
0.001833	0.000000	0.001833
0.001000	0.000000	0.001000
0.000000	0.000000	0.000000
0.000000	0.000000	0.000000
0.000000	0.000000	0.000000
0.679419	0.021760	0.701179
0.682252	0.021760	0.704012

Power by Block (W) Peak Startup	
Logic Block	0.448581
Clocks	0.021009
I/O	0.067653
Block RAM	0.091026
EFB	0.016674
PLL	0.000044
DQS DLL	0.001276
DLL DEL	0.001092
Other	0.056657
Total	0.704012

Figure 3.1. Diamond 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), MachXO3D (LCMXO3D), and MachXO4 (LFMXO4) 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 or Radiant 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 \(FPGA-DS-02026\)](#)
- [MachXO4 Family Data Sheet \(FPGA-DS-02125\)](#)
- [MachXO3 web page](#)
- [MachXO3D web page](#)
- [MachXO4 web page](#)
- [Lattice Radiant FPGA design software](#)
- [Lattice Insights](#) for Lattice Semiconductor training courses and learning plans

Technical Support Assistance

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

For frequently asked questions, please refer to the Lattice Answer Database at www.latticesemi.com/Support/AnswerDatabase.

Revision History

Revision 1.2, December 2025

Section	Change Summary
All	<ul style="list-style-type: none">Changed document title from Temperature Excursion Usage Guide for Lattice Devices to <i>Temperature Excursion User Guide for MachXO3 and MachXO4 Devices</i>.Made editorial fixes across the document.
Temperature Excursion Supported Devices	Updated section content to add MachXO3 devices and MachXO4 information, updated references to Radiant and Diamond web pages respectively, and updated Table 2.1. Devices Supporting Temperature Excursion to add LFMXO4 device.
Power Calculator	<ul style="list-style-type: none">Added Radiant support in the section content.Updated figure caption to Figure 3.1. Diamond Power Calculator – Power Summary Tab.
Summary	Added MachXO4 and Radiant support in the section content.
References	Added reference to the MachXO3 and MachXO3D web pages and MachXO4 Family data sheet and web page.

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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