



# Trion<sup>®</sup> Reliability Report

---

TRR-v12.0  
December 2023  
[www.efinixinc.com](http://www.efinixinc.com)



# Contents

<b>Introduction .....</b>	<b>3</b>
<b>Efinix Product Qualification Program .....</b>	<b>4</b>
Reliability Qualification Requirements .....	4
Extension Reliability Test and Result by Similarity .....	5
<b>ESD and Latch Up Qualification Data.....</b>	<b>6</b>
Electrostatic Discharge - Human Body Model (ESD-HBM).....	6
Electrostatic Discharge - Charged Device Model (ESD-CDM).....	7
Latch-Up (LU) .....	8
<b>Life Data .....</b>	<b>9</b>
High-Temperature Operating Life (HTOL) .....	9
<b>Package Qualification Data .....</b>	<b>9</b>
Preconditioning (PC).....	9
Temperature Cycling (TC) .....	11
Unbiased HAST (uHAST) .....	12
High-Temperature Storage Life (HTSL) .....	13
Temperature Humidity Bias (THB).....	14
Nonvolatile Memory Uncycled High Temperature Data Retention (UCHTDR) .....	14
<b>Revision History .....</b>	<b>15</b>

# Introduction

Efinix® Trion® FPGAs feature a programmable logic and routing fabric built with the Quantum™ architecture. The initial phase of the Trion platform consists of eight devices, built on SMIC's 40LL process, with a logic density range from 4K to 120K logic elements (LEs) and standard interfaces such as GPIO, PLLs, oscillators, MIPI, DDR, and LVDS.

This reliability report provides the reliability results for Trion® FPGAs. Efinix ensures standards compliance with this report.

# Efinix Product Qualification Program

Efinix qualifies FPGAs using various reliability conditions.

## Reliability Qualification Requirements

**Table 1: Reliability Qualification Requirements**

Refer to the data in the following sections for the sample size for each condition.

Reliability Condition	JEDEC Standard	Test Condition
Electrostatic Discharge – Human Body Model (HBM)	JS-001	Class 2, $\leq 2,000V$
Electrostatic Discharge – Charged Device Model (CDM)	JS-002	Class C2a, $\leq 500V$
Latch-Up (LU)	JESD78	Class II, $\pm 100$ mA trigger current $V_{CC} + 50\%$ on power supplies
Preconditioning (PC)	J-STD-020, JESD22-A113	Bake at $125^{\circ}C$ , 24 hours
		MSL 1: $85^{\circ}C/85\%$ RH, 168 hours
		MSL 3: $30^{\circ}C/60\%$ RH, 192 hours
High Temperature Operating Life (HTOL)	JESD22-A108	3 reflow cycles at $260^{\circ}C$
		$125^{\circ}C$ , 168 hours
		$125^{\circ}C$ , 500 hours
Temperature Cycling (TC)	JESD22-A104	$125^{\circ}C$ , 1,000 hours
		$-55^{\circ}C/125^{\circ}C$ , 500 cycles or $-65^{\circ}C/150^{\circ}C$ , 500 cycles
		$-55^{\circ}C/125^{\circ}C$ , 1,000 cycles or $-65^{\circ}C/150^{\circ}C$ , 1,000 cycles
High Temperature Storage Life (HTSL)	JESD22-A103	$150^{\circ}C$ , 168 hours
		$150^{\circ}C$ , 500 hours
		$150^{\circ}C$ , 1,000 hours
Unbiased Highly Accelerated Stress Test (uHAST)	JESD22-A118	$130^{\circ}C/85\%$ RH, 96 hours
		$130^{\circ}C/85\%$ RH, 192 hours
Temperature Humidity Bias (THB)	JESD22-A101	$85^{\circ}C/85\%$ RH, $V_{CC}$ max, 500 hours
		$85^{\circ}C/85\%$ RH, $V_{CC}$ max, 1000 hours
Nonvolatile Memory Uncycled High Temperature Data Retention (UCHTDR)	JESD22-A117	$150^{\circ}C$ , 168 hours
		$150^{\circ}C$ , 500 hours
		$150^{\circ}C$ , 1,000 hours

## Extension Reliability Test and Result by Similarity

The generation and use of generic data applied across a family of packages emanating from one base assembly process is a family qualification, or Qualification-by-Similarity (QBS). The package stresses uHAST and HTSL are considered generic for a given package technology. TC is considered generic up to an evaluated die size + package size + 10% for a given package technology. Pre-Conditioning (PC) is considered generic up to an evaluated peak reflow temperature for a given package technology.

# ESD and Latch Up Qualification Data

The following sections describe the electrostatic discharge and latch-up test results.

## Electrostatic Discharge - Human Body Model (ESD-HBM)

The Trion® product family was tested per the JS-001 Electrostatic Discharge (ESD) Sensitivity Test – Human Body Model – Component Level JEDEC Standard procedure.

- *Test room ambient conditions*—Room temperature, humidity <60% RH
- *Test condition*—Class 2, ≤2,000V

**Table 2: ESD-HBM Data**

Device	Package	Sample Size	Result
T4	FBGA 49	-	QBS
	FBGA 81	-	QBS
T8	FBGA 49	3 units x 3 lots	Pass
	FBGA 81	3 units x 3 lots	Pass
	LQFP 144	-	QBS
T13	FBGA 169	-	QBS
	FBGA 256	-	QBS
	LQFP 100 SIP	-	QBS
T20	WLCSP 80	-	QBS
	FBGA 169	3 units x 3 lots	Pass
	FBGA 256	3 units x 3 lots	Pass
	FBGA 324	-	QBS
	FBGA 400	-	QBS
	LQFP 100 SIP	-	QBS
T35	FBGA 324	3 units x 3 lots	Pass
	FBGA 400	3 units x 1 lot	Pass
T55	FBGA 324	-	QBS
	FBGA 484	-	QBS
	FBGA 576	-	QBS
T85	FBGA 324	-	QBS
	FBGA 484	-	QBS
	FBGA 576	-	QBS
T120	FBGA 324	3 units x 1 lot	Pass
	FBGA 484	3 units x 1 lot	Pass
	FBGA 576	3 units x 1 lot	Pass

## Electrostatic Discharge - Charged Device Model (ESD-CDM)

The Trion® product family was tested per the JS-002 Electrostatic Discharge (ESD) Sensitivity Testing – Charged Device Model (CDM) – Device Level JEDEC Standard procedure.

- *Test room ambient conditions*—Room temperature, humidity <60% RH
- *Test condition*—Class C2a, ≤500V

**Table 3: ESD-CDM Data**

Device	Package	Sample Size	Result
T4	FBGA 49	–	QBS
	FBGA 81	–	QBS
T8	FBGA 49	3 units x 3 lots	Pass
	FBGA 81	3 units x 3 lots	Pass
	LQFP 144	–	QBS
T13	FBGA 169	–	QBS
	FBGA 256	–	QBS
	LQFP 100 SIP	–	QBS
T20	WLCSP 80	–	QBS
	FBGA 169	3 units x 3 lots	Pass
	FBGA 256	3 units x 3 lots	Pass
	FBGA 324	–	QBS
	FBGA 400	–	QBS
	LQFP 100 SIP	–	QBS
T35	FBGA 324	3 units x 1 lot	Pass
	FBGA 400	3 units x 1 lot	Pass
T55	FBGA 324	–	QBS
	FBGA 484	–	QBS
	FBGA 576	–	QBS
T85	FBGA 324	–	QBS
	FBGA 484	–	QBS
	FBGA 576	–	QBS
T120	FBGA 324	3 units x 1 lot	Pass
	FBGA 484	3 units x 1 lot	Pass
	FBGA 576	3 units x 1 lot	Pass

## Latch-Up (LU)

The Trion® product family was tested per the JESD78 Latch-up JEDEC Standard procedure.

- *Test room ambient conditions*—Room temperature, humidity <60% RH
- *Test condition*—±100 mA trigger current,  $V_{CC} + 50\%$  on power supplies, 125 °C

**Table 4: LU Data**

Device	Package	Sample Size	Result
T4	FBGA 49	–	QBS
	FBGA 81	–	QBS
T8	FBGA 49	3 units x 3 lots	Pass
	FBGA 81	3 units x 3 lots	Pass
	FQFP 144	–	QBS
T13	FBGA 169	–	QBS
	FBGA 256	–	QBS
	LQFP 100 SIP	–	QBS
T20	WLCSP 80	–	QBS
	FBGA 169	3 units x 3 lots	Pass
	FBGA 256	3 units x 3 lots	Pass
	FBGA 324	–	QBS
	FBGA 400	–	QBS
	LQFP 100 SIP	–	QBS
T35	FBGA 324	3 units x 1 lot	Pass
	FBGA 400	3 units x 1 lot	Pass
T55	FBGA 324	–	QBS
	FBGA 484	–	QBS
	FBGA 576	–	QBS
T85	FBGA 324	–	QBS
	FBGA 484	–	QBS
	FBGA 576	–	QBS
T120	FBGA 324	3 units x 1 lot	Pass
	FBGA 484	3 units x 1 lot	Pass
	FBGA 576	3 units x 1 lot	Pass



# Life Data

This section describes the results of life testing.

## High-Temperature Operating Life (HTOL)

The Trion® product family was tested per the JESD22-A108 High Temperature Operating Life (HTOL) JEDEC Standard procedure.

- *Stress duration*—168, 500, and 1,000 hours
- *Stress condition*— $T_a = 125^\circ\text{C}$ , maximum operating voltage

**Table 5: HTOL Data**

Device	Package	Sample Size	Result
T4	FBGA 81	–	QBS
T8	FBGA 81	77 units x 3 lots	Pass*
T13	FBGA 169	–	QBS
T20	FBGA 169	77 units x 3 lots	Pass
T55	FBGA 576	–	QBS
T85	FBGA 576	–	QBS
T120	FBGA 576	77 units x 3 lots	Pass

*\*Note: 1<sup>st</sup> and 2<sup>nd</sup> lots are qualified using T8\_FBGA81 devices. 3<sup>rd</sup> lot is qualified by similarity using HTOL data from T20\_FBGA169 device. T8\_FBGA81 and T20\_FBGA169 are fabricated using same foundry process, T20\_FBGA169 device has larger die size than T8\_FBGA81 device.*

# Package Qualification Data

The following sections describe the results of package qualification testing.

## Preconditioning (PC)

The Trion® product family was tested per the J-STD-020 and JESD22-A113 JEDEC Standard procedure with Moisture Sensitivity Level 1 (MSL 1) or Level 3 (MSL 3). All devices stressed through temperature cycling and unbiased HAST were preconditioned.

**Table 6: PC Data**

MSL 1: 24 hours bake at  $125^\circ\text{C}$ ,  $85^\circ\text{C}/85\% \text{RH}$ , 168 hours, 3 reflow cycles at  $260^\circ\text{C}$

Device	Package	Sample Size	Result
T20	WLCSP 80	77 units x 3 lots	Pass

**Table 7: PC Data**

MSL 3: 24 hours bake at 125 °C, 30 °C/60% RH, 192 hours, 3 reflow cycles at 260 °C

Device	Package	Sample Size	Result
T4	FBGA 49	-	QBS
	FBGA 81	-	QBS
T8	FBGA 49	77 units x 3 lots	Pass
	FBGA 81	77 units x 3 lots	Pass
	LQFP 144	77 units x 3 lots	Pass
T13	FBGA 169	-	QBS
	FBGA 256	-	QBS
	LQFP 100 SIP	-	QBS
T20	FBGA 169	77 units x 3 lots	Pass
	FBGA 256	77 units x 3 lots	Pass
	FBGA 324	-	QBS
	FBGA 400	-	QBS
	LQFP 100 SIP	77 units x 3 lots	Pass
T35	FBGA 324	77 units x 3 lots	Pass
	FBGA 400	77 units x 3 lots	Pass
T55	FBGA 324	-	QBS
	FBGA 484	-	QBS
	FBGA 576	-	QBS
T85	FBGA 324	-	QBS
	FBGA 484	-	QBS
	FBGA 576	-	QBS
T120	FBGA 324	77 units x 3 lots	Pass
	FBGA 484	77 units x 3 lots	Pass
	FBGA 576	77 units x 3 lots	Pass

## Temperature Cycling (TC)

The Trion® product family was tested per the JESD22-A104 JEDEC Standard procedure. The stress duration was 500 and 1,000 cycles.

**Table 8: TC Data**

Stress condition: -65 °C / 150 °C

Device	Package	Sample Size	Result
T20	WLCSP 80	77 units x 3 lots	Pass

**Table 9: TC Data**

Stress condition: -55 °C / 125 °C

Device	Package	Sample Size	Result
T4	FBGA 49	-	QBS
	FBGA 81	-	QBS
T8	FBGA 49	77 units x 3 lots	Pass
	FBGA 81	77 units x 3 lots	Pass
	LQFP 144	77 units x 3 lots	Pass
T13	FBGA 169	-	QBS
	FBGA 256	-	QBS
	LQFP 100 SIP	-	QBS
T20	FBGA 169	77 units x 3 lots	Pass
	FBGA 256	77 units x 3 lots	Pass
	FBGA 324	-	QBS
	FBGA 400	-	QBS
	LQFP 100 SIP	77 units x 3 lots	Pass
T35	FBGA 324	77 units x 3 lots	Pass
	FBGA 400	77 units x 3 lots	Pass
T55	FBGA 324	-	QBS
	FBGA 484	-	QBS
	FBGA 576	-	QBS
T85	FBGA 324	-	QBS
	FBGA 484	-	QBS
	FBGA 576	-	QBS
T120	FBGA 324	77 units x 3 lots	Pass
	FBGA 484	77 units x 3 lots	Pass
	FBGA 576	77 units x 3 lots	Pass

## Unbiased HAST (uHAST)

The Trion® product family was tested per the JESD22-A118 JEDEC Standard procedure.

- *Stress duration*—96 and 192 hours
- *Stress condition*—130 °C/85% RH

**Table 10: uHAST Data**

Device	Package	Sample Size	Result
T4	FBGA 49	–	QBS
	FBGA 81	–	QBS
T8	FBGA 49	77 units x 3 lots	Pass
	FBGA 81	77 units x 3 lots	Pass
	LQFP 144	77 units x 3 lots	Pass
T13	FBGA 169	–	QBS
	FBGA 256	–	QBS
	LQFP 100 SIP	–	QBS
T20	WLCSP 80	77 units x 3 lots	Pass
	FBGA 169	77 units x 3 lots	Pass
	FBGA 256	77 units x 3 lots	Pass
	FBGA 324	–	QBS
	FBGA 400	–	QBS
	LQFP 100 SIP	77 units x 3 lots	Pass
T35	FBGA 324	77 units x 3 lots	Pass
	FBGA 400	77 units x 3 lots	Pass
T55	FBGA 324	–	QBS
	FBGA 484	–	QBS
	FBGA 576	–	QBS
T85	FBGA 324	–	QBS
	FBGA 484	–	QBS
	FBGA 576	–	QBS
T120	FBGA 324	77 units x 3 lots	Pass
	FBGA 484	77 units x 3 lots	Pass
	FBGA 576	77 units x 3 lots	Pass

## High-Temperature Storage Life (HTSL)

The Trion® product family was tested per the JESD22-A103 JEDEC Standard procedure.

- *Stress duration*—168, 500, and 1,000 hours
- *Stress condition*—  $T_a = 150\text{ }^{\circ}\text{C}$

**Table 11: HTSL Data**

Device	Package	Sample Size	Result
T4	FBGA 49	–	QBS
	FBGA 81	–	QBS
T8	FBGA 49	77 units x 3 lots	Pass
	FBGA 81	77 units x 3 lots	Pass
	LQFP 144	77 units x 3 lots	Pass
T13	FBGA 169	–	QBS
	FBGA 256	–	QBS
	LQFP 100 SIP	–	QBS
T20	WLCSP 80	77 units x 3 lots	Pass
	FBGA 169	77 units x 3 lots	Pass
	FBGA 256	77 units x 3 lots	Pass
	FBGA 324	–	QBS
	FBGA 400	–	QBS
	LQFP 100 SIP	77 units x 3 lots	Pass
T35	FBGA 324	77 units x 3 lots	Pass
	FBGA 400	77 units x 3 lots	Pass
T55	FBGA 324	–	QBS
	FBGA 484	–	QBS
	FBGA 576	–	QBS
T85	FBGA 324	–	QBS
	FBGA 484	–	QBS
	FBGA 576	–	QBS
T120	FBGA 324	77 units x 3 lots	Pass
	FBGA 484	77 units x 3 lots	Pass
	FBGA 576	77 units x 3 lots	Pass

## Temperature Humidity Bias (THB)

The Trion® product family was tested per the JESD22-A101 JEDEC Standard procedure.

- *Stress duration*— 500, and 1,000 hours
- *Stress condition*— 85 °C/85% RH,  $V_{cc}$  max

**Table 12: THB Data**

Device	Package	Sample Size	Result
T13	FBGA 256	-	QBS
T20	FBGA 256	77 units x 3 lots	Pass
T55	FBGA 484	-	QBS
T85	FBGA 484	-	QBS
T120	FBGA 484	77 units x 3 lots	Pass

## Nonvolatile Memory Uncycled High Temperature Data Retention (UCHTDR)

The Trion® product family was tested per the JESD22-A117 JEDEC Standard procedure.

- *Stress duration*—168, 500, and 1,000 hours
- *Stress condition*—  $T_a = 150$  °C

**Table 13: UCHTDR Data**

Device	Package	Sample Size	Result
T13	LQFP 100 SIP	-	QBS
T20	LQFP 100 SIP	77 units x 3 lots	Pass

# Revision History

Date	Version	Description
December 2023	12.0	Add qualification data for T13 LQFP100 SIP and T20 LQFP100 SIP packages. Add THB data for T13/T20 FBGA256 and T55/T85/T120 FBGA484 packages.
May 2023	11.0	Added HTOL results for T8 FBGA81, T20 FBGA169 and T120 FBGA576 packages.
June 2021	10.0	Added qualification data for T20 WLCSP80 package. Added HTOL results for T55, T85, and T120 in the 576-ball FPGA package.
April 2021	9.1	Corrected introduction (LE count, interface feature list, and applicable FPGAs for this document). (DOC-423)
November 2020	9.0	Added qualification data for T55, T85, and T120 FPGAs in the 576-ball FBGA package.
September 2020	8.0	Added qualification data for T20 and T35 FPGAs in the 400-ball FBGA package.
May 2020	7.0	Added sample size data in reliability qualification requirements. Added HTOL data for T13 and T20 FPGAs in the 169-ball FBGA package.
April 2020	6.0	Added qualification data for T20, T35, T55, T85, and T120 FPGAs in the 324-ball FBGA package.
March 2020	5.0	Added qualification data for T55, T85, and T120 FPGAs in the 484-ball FBGA package.
January 2020	4.0	Added qualification data for T8 FPGAs in the 144-pin LQFP package.
August 2019	3.1	Added life testing data for T4 and T8 FPGAs.
July 2019	3.0	Added qualification data for T13 and T20 FPGAs in the 169-ball FBGA package.
April 2019	2.0	Added qualification data for T13 and T20 FPGAs in the 256-ball FBGA package.
October 2018	1.0	Initial release.