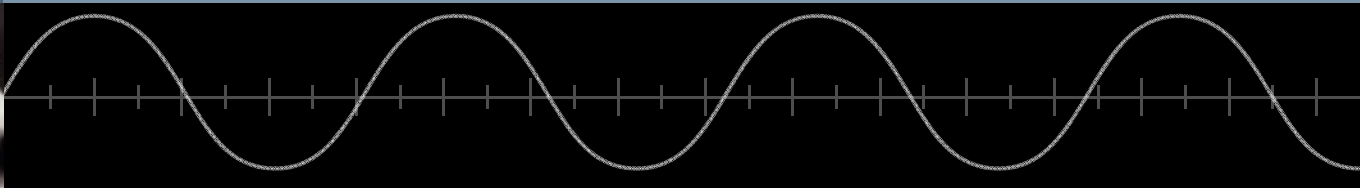


# Linear Technology Corporation Reliability Test Criteria For Automotive Grade Products



# AEC- Q100 Test Requirements

AEC-Q100 is a set of reliability stress tests defined by the Automotive Electronics Council for the purpose of qualifying integrated circuits (ICs) for automotive applications. Linear qualifies products based on AEC-Q100 guidelines and guarantees that all automotive products exceed current AEC-Q100 requirements by conducting additional device and package level stress tests.

These additional tests may include, but are not limited to the following: Power cycling, liquid-to-liquid thermal shock, instant solder shock, and 100% oxide stress tests. These unique and rigorous tests validate the robustness of Linear's products prior to production release.

## Summary of AEC- Q100 Guideline

STRESS	ABV	#	# of LOTS	SS / LOT	ACC	METHOD
Preconditioning	PC	A1	3	77	Ø	JEDEC J-STD-020 JESD A113
Temperature-Humidity-Bias or Biased HAST	THB or HAST	A2	1	45	Ø	JEDEC JESD22 A101 or A110
Autoclave or Unbiased HAST	AC or HAST	A3	3	77	Ø	JEDEC JESD22 A102 or A116
Temperature Cycling	TC	A4	3	77	Ø	JEDEC JESD22 A104 and Appendix 3
Power Temp Cycle	PTC	A5	1	45	Ø	JEDEC JESD22 A105
High Temperature Storage Life	HTSL	A6	3	77	Ø	JEDEC JESD22 A103
High Temperature Operating Life	HTOL	A7	3	77	Ø	JEDEC JESD22 A108
Early Life Failure Rate	ELFR	B2	3	800	Ø	AEC Q100-008
NVM Endurance, Data Retention, and Operational Life	EDR	B3	3	77	Ø	AEC Q00-005
<b>PACKAGE ASSEMBLY INTEGRITY TESTS</b>						
Wire Bond Shear	WBS	C1	Per Shift	30 Bonds	Cpk >1.33 Ppk >1.67	AEC-Q100-001
Wire Bond Pull	WBP	C2	Per Shift	30 Bonds	Cpk >1.33 Ppk >1.67	MIL-STD-883 M2011
Solderability	SD	C3	1	15	Cpk >1.33 Ppk >1.67	JEDEC JESD22 B102
Physical Dimensions	PD	C4	3	10	Cpk >1.33 Ppk >1.67	JEDEC JESD22 B100 & B106
Solder Ball Shear	SBS	C5	3	5 X 10	Cpk >1.33 Ppk >1.67	AEC Q100-010
Lead Integrity	LI	C6	1	5 X 10	Ø	JEDEC JESD22 B105

<b>DIE FABRICATION INTEGRITY TESTS</b>						
Electromigration	EM	D1	-	-	-	JESD 87 and JESD 202
Time Dependant Dielectric Breakdown	TDDB	D2	-	-	-	JESD 92
Hot Carrier Injection / Beta Degradation	HCI	D3	-	-	-	JESD 28
Negative Bias Temp Instability	NBTI	D4	-	-	-	JESD 90
Stress Migration	SM	D5	-	-	-	JESD 202
<b>ELECTRICAL VERIFICATION</b>						
Pre- and Post-Stress Function/Parameter	TEST	E1	ALL	ALL	Ø	ATE
Electrostatic Discharge Human Body Model / Machine Model	HBM / MM	E2	1	3 per Step	N/A	AEC Q100-002 & 003
Electrostatic Discharge Charged Device Model	CDM	E3	1	3 per Step	N/A	AEC Q100-011
Latch-up	LU	E4	1	6	N/A	AEC Q100-004
Electrical Distributions	ED	E5	3	30	Cpk >1.33	AEC Q100-009
Fault Grading	FG	E6	-	-	-	AEC Q100-007
Characterization	CHAR	E7	-	-	-	AEC Q003
Electrothermally Induced Gate Leakage	GL	E8	1	6	Ø	AEC Q100-006
Electromagnetic Compatibility	EMC	E9	1	1	Ø	SAE J1752/3 - Radiated Emission
Short Circuit Characterization	SC	E10	3	10	Ø	AEC Q100-012
Soft Error Rate	SER	E11	1	3	Ø	JESD 89-1/2/3
Process Average Testing	PAT	F1	-	-	-	AEC Q001
Statistical Bin/Yield Analysis	SBA	F2	-	-	-	AEC Q002



To simulate worst case field and environmental operating conditions, Linear conducts reliability tests using conditions that are more rigorous than what is required by AEC-Q100 specifications (e.g. extended test durations or greater temperature ranges).

**❑ Mechanical Stresses (grade 1 conditions listed below as an example)**

Preconditioning (typically moisture sensitivity level 1) - 168 hours of +85°C/85% relative humidity moisture soak and 3 times reflow at +260°C followed by:

- 168 hour Pressure Cooker Test at 15 PSIG, +121°C (J-PCT).
- 1000 cycles of Temperature Cycle from -65°C to +150°C (J-TC)
- 1000 cycles of Thermal Shock from -65°C to +150°C (J-TS)\*\*
- Solder Shock at +245°C (SDRSHK)\*\*
- 1000 hrs of High Temperature Storage at +175°C or +150°C (HTSL)

**❑ Voltage Bias Stresses**

- 1000 hr Operating Life Test at rated junction temperature (HTOL)
- 168 hr humidity bias test at +130°C/85% relative humidity (HAST)
- 100% Oxide Stress Test to remove potential oxide infant mortality failure\*\*

**❑ Whisker Growth Evaluation**

- Per JEDEC-201, up to 4000 hrs of 55°C/85%RH moisture soak and 4000 temperature cycles between -55°C and +85°C

**❑ Power Cycling (for monolithic power management products)**

- Up to 100,000 cycles under full load condition with delta Tj= 50C (50°C to 100°C) for power package products

**\*Product Grade Definition**

	Operating temperature range	
<b>Grade 0</b>	-40°C	+150°C
<b>Grade 1</b>	-40°C	+125°C
<b>Grade 2</b>	-40°C	+105°C
<b>Grade 3</b>	-40°C	+85°C
<b>Grade 4</b>	0°C	+70°C

Note: Test sample sizes and conditions conform to and often exceed JEDEC, AEC-Q100, and MIL-STD-883 specifications.

\*\*Note: (additional test, not an AEC-Q100 requirement)

