

Report No. MCR-22-0739

Date: Dec./1/2022

RENESAS SEMICONDUCTOR

RELIABILITY REPORT

SERIES : RL78/F12

DEVICE : R5F109AxySP/R5F109AxyXXXSP
(x=A/B/C/D/E,y=J/K)

APPLICATION : Automobile

Quality Assurance Div.
Renesas Electronics Corporation

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Q100 Qualification Test Results for R5F109AxySP/R5F109AxyXXXSP(x=A/B/C/D/E,y=J/K)

[Note : Basically qualification tests were performed using a representative product with the same wafer process and the same package structure .]

Test	#	Reference	Test Conditions	Lots	S.S.	Total	Results (Fail of Total)	Comments: (N/A =Not Applicable)
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TEST GROUP A – ACCELERATED ENVIRONMENT STRESS TESTS

PC	A1	JESD22 A113 J-STD-020	Preconditioning: (Test @ Rm) SMD only; Moisture Preconditioning for THB/HAST, AC/UHST, TC, &PTC ; Peak Reflow Temp=260°C	Min.MSL=3			MSL=3	-
THB or HAST	A2	JESD22 A101	Temperature Humidity Bias: (Test @ Rm/Hot) Ta=85°C, RH=85%, 1000hrs	3	77	231	0 of 231	-
AC or UHST or TH	A3	JESD22 A102	Autoclave : (Test @ Rm) Ta=121°C, P=2atm, RH=100%, 96hrs	3	77	231	0 of 231	-
TC	A4	JESD22 A104	Temperature Cycle: (Test @ Hot) Ta=-65°C to 150°C, 500cyc	3	77	231	0 of 231	-
PTC	A5	JESD22 A105	Power Temperature Cycle: (Test @ Rm/Hot)	-	-	-	-	N/A
HTSL	A6	JESD22 A103	High Temperature Storage Life: (Test @ Rm/Hot) Ta=150°C, 1000hrs	1	45	45	0 of 45	-

TEST GROUP B – ACCELERATED LIFETIME SIMULATION TESTS

HTOL	B1	JESD22 A108	High Temp Operating Life: (Test @ Rm/Cold/Hot) Ta=125°C, 1000hrs	3	77	231	0 of 231	-
ELFR	B2	AEC-Q100-008	Early Life Failure Rate: (Test @ Rm/Hot) Ta=125°C, 48hrs	3	800	2400	0 of 2400	-
EDR	B3	AEC-Q100-005	NVM Endurance & Data Retention Test: (Test @ Rm/Hot)	For HTOL	3	77	231	0 of 231
				For HTSL	1	45	45	0 of 45

Test	#	Reference	Test Conditions	Lots	S.S.	Total	Results (Fail of Total)	Comments: (N/A =Not Applicable)
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TEST GROUP C – PACKAGE ASSEMBLY INTEGRITY TESTS

WBS	C1	AEC-Q100-001	Wire Bond Shear Test: (Ppk > 1.67 and Cpk > 1.33)	30 bonds	5 parts Min.	30 bonds	0 of 30bonds	Ppk>1.67
WBP	C2	Mil-STD-883 Method 2011	Wire Bond Pull: (Ppk > 1.67 and Cpk > 1.33); Each bonder used	30 bonds	5 parts Min.	30 bonds	0 of 30bonds	Ppk>1.67
SD	C3	JESD22 B102	Solderability: (>95% coverage) Solder temp: 245C, Solder Immersion time: 5sec	1	15	15	0 of 15	-
PD	C4	JESD22 B100, JESD22 B108	Physical Dimensions: (Ppk > 1.67 and Cpk > 1.33)	3	10	30	0 of 30	Ppk>1.67
SBS	C5	AEC-Q100-010	Solder Ball Shear: (Ppk > 1.67 and Cpk > 1.33)	-	-	-	-	N/A
LI	C6	JESD22 B105	Lead Integrity: (No lead cracking or breaking); Through-hole only	-	-	-	-	N/A

TEST GROUP D – DIE FABRICATION RELIABILITY TESTS

EM	D1	JESD61	Electromigration:	-	-	-	Pass	Confirmed by process TEG
TDDB	D2	JESD35	Time Dependant Dielectric Breakdown:	-	-	-	Pass	Confirmed by process TEG
HCI	D3	JESD60 & 28	Hot Carrier Injection:	-	-	-	Pass	Confirmed by process TEG
NBTI	D4	JESD90	Negative Bias Temperature Instability:	-	-	-	Pass	Confirmed by process TEG
SM	D5	JESD61,87 & 202	Stress Migration:	-	-	-	Pass	Confirmed by process TEG

Test	#	Reference	Test Conditions	Lots	S.S.	Total	Results (Fail of Total)	Comments: (N/A =Not Applicable)
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TEST GROUP E- ELECTRICAL VERIFICATION

TEST	E1	User/Supplier Specification	Pre and Post Stress Electrical Test:	All	All	All	0 of All	-
HBM/ MM	E2	AEC-Q100-002 AEC-Q100-003	Electrostatic Discharge, Human Body Model / Machine Model: (Test @ Rm/Hot); (2KV HBM / 200V MM) At least one of these models must be performed.	1	HBM:3 MM:3	6	0 of 6 ESD Level= HBM: H2 MM: M3	HBM: 2000V Pass MM: 200V Pass
CDM	E3	AEC-Q100-011	Electrostatic Discharge, Charged Device Model: (Test @ Rm/Hot); (750V corner leads, 500V all other leads)	1	3	3	0 of 3 ESD Level= CDM: C4B	Corner leads: 750V Pass All other leads:500V Pass *Only Direct charge method
LU	E4	AEC-Q100-004	Latch-Up: (Test @ Rm/Hot)	1	6	6	0 of 6	-
ED	E5	AEC-Q100-009 AEC-Q003	Electrical Distributions: (Test @ Rm/Hot/Cold) (Cpk > 1.33, Ppk > 1.67)	3	30	90	0 of 90	Ppk>1.67
FG	E6	AEC-Q100-007	Fault Grading:	-	-	-	>98%	-
CHAR	E7	AEC-Q003	Characterization: (Test @ Rm/Hot/Cold)	-	-	-	Pass	According to Renesas standard procedure
GL	E8	AEC-Q100-006	Electro-Thermally Induced Gate Leakage: (Test @ Rm)	1	6	6	0 of 6	-
EMC	E9	SAE J1752/3	Electromagnetic Compatibility (Radiated Emissions)	1	1	1	0 of 1	-
SC	E10	AEC Q100-012	Short Circuit Characterization	-	-	-	-	N/A
SER	E11	JESD89-1 JESD89-2 JESD89-3	Soft Error Rate	1	3	3	Pass	-

Test	#	Reference	Test Conditions	Lots	S.S.	Total	Results (Fail of Total)	Comments: (N/A =Not Applicable)
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TEST GROUP F – DEFECT SCREENING TESTS

PAT	F1	AEC-Q001	Process Average Testing: (see AEC-Q001)	All	All	All	Reject units outside PAT limits	Apply to mass production according to Renesas standard procedure
SBA	F2	AEC-Q002	Statistical Bin/Yield Analysis: (see AEC-Q002)	All	All	All	Reject units outside criteria	Apply to mass production according to Renesas standard procedure

TEST GROUP G – CAVITY PACKAGE INTEGRITY TESTS (for Ceramic Package testing only)

MS	G1	JESD22 B104	Mechanical Shock: (Test @ Rm)	-	-	-	-	N/A
VFV	G2	JESD22 B103	Variable Frequency Vibration: (Test @ Rm)	-	-	-	-	N/A
CA	G3	MIL-STD-883 Method 2001	Constant Acceleration: (Test @ Rm)	-	-	-	-	N/A
GFL	G4	MIL-STD-883 Method 1014	Gross and Fine Leak:	-	-	-	-	N/A
DROP	G5	-----	Drop Test: (Test @ Rm) MEMS cavity parts only. Drop part on each of 6 axes once from a height of 1.2m onto a concrete surface.	-	-	-	-	N/A
LT	G6	MIL-STD-883 Method 2004	Lid Torque:	-	-	-	-	N/A
DS	G7	MIL-STD-883 Method 2019	Die Shear:	-	-	-	-	N/A
IWV	G8	MIL-STD-883 Method 1018	Internal Water Vapor:	-	-	-	-	N/A

Calculation method of standard failure rate

Target : 0.13um CMOS process product (RL78 series Automobile)

Operating reliability is decided by inherent reliability of device and environment condition of use (See below).

Calculation method of standard failure rate (λ)

$$\lambda = \lambda_b \times \pi T \quad (\text{FIT})$$

λ_b → (1) Basic failure rate
 πT → (2) Temperature parameter

(1) Basic failure rate (λ_b)

λ_b : 0.18 (FIT)

(2) Temperature parameter

$$\pi T = \exp \left\{ 11600 \times E_a \times \left(\frac{1}{273+55} - \frac{1}{273+T_a} \right) \right\}$$

E_a : Activation energy (eV)

T_a : ambient temperature

πT Simplified chart ($E_a=0.7\text{eV}$)

$T_a(^{\circ}\text{C})$	40	50	55	60	65	70	75	80	85	90	100	110
πT	0.31	0.68	1	1.45	2.08	2.95	4.15	5.77	7.96	10.88	19.82	34.99

-Confidence level 60% -Standard temperature $T_a=55^{\circ}\text{C}$

(3) MTTF (Mean Time To Failure)

$$\text{MTTF} = \frac{1}{\lambda}$$

Product list

Report No. MCR-22-0739

No	Group	Product part number	Package code	No	Group	Product part number	Package code
1	RL78/F12	R5F109AAJSP	PLSP0030JB-B	51			
2	RL78/F12	R5F109AAJXXXSP	PLSP0030JB-B	52			
3	RL78/F12	R5F109AAKSP	PLSP0030JB-B	53			
4	RL78/F12	R5F109AAKXXXSP	PLSP0030JB-B	54			
5	RL78/F12	R5F109ABJSP	PLSP0030JB-B	55			
6	RL78/F12	R5F109ABJXXXSP	PLSP0030JB-B	56			
7	RL78/F12	R5F109ABKSP	PLSP0030JB-B	57			
8	RL78/F12	R5F109ABKXXXSP	PLSP0030JB-B	58			
9	RL78/F12	R5F109ACJSP	PLSP0030JB-B	59			
10	RL78/F12	R5F109ACJXXXSP	PLSP0030JB-B	60			
11	RL78/F12	R5F109ACKSP	PLSP0030JB-B	61			
12	RL78/F12	R5F109ACKXXXSP	PLSP0030JB-B	62			
13	RL78/F12	R5F109ADJSP	PLSP0030JB-B	63			
14	RL78/F12	R5F109ADJXXXSP	PLSP0030JB-B	64			
15	RL78/F12	R5F109ADKSP	PLSP0030JB-B	65			
16	RL78/F12	R5F109ADKXXXSP	PLSP0030JB-B	66			
17	RL78/F12	R5F109AEJSP	PLSP0030JB-B	67			
18	RL78/F12	R5F109AEJXXXSP	PLSP0030JB-B	68			
19	RL78/F12	R5F109AEKSP	PLSP0030JB-B	69			
20	RL78/F12	R5F109AEKXXXSP	PLSP0030JB-B	70			
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