Report No. MCR-22-0750
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RENESAS SEMICONDUCTOR
RELIABILITY REPORT

SERIES : RL78/F13

DEVICE : R5F10BBxyNA/R5F10BBxyXXXNA
(x=C/D/E/F/G,y=L/K)

APPLICATION : Automobile

Quality Assurance Div.
Renesas Electronics Corporation

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(Rev.5.0-2 October 2020)

Q100 Qualification Test Results for R5F10BBxyNA/R5F10BBxyXXXNA(x=C/D/E/F/G,y=L/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)
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)
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)
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)
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)

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

(2)Temperature parameter

(1)Basic failure rate

(1)Basic failure rate(λb)

λb : 0.18 (FIT)

(2)Temperature parameter

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

Ea : Activation energy (eV)
Ta : ambient temperature

πT Simplified chart (Ea=0.7eV)

Ta(℃)	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 Ta=55ºC

(3)MTTF (Mean Time To Failure)

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

No	Group	Product part number	Package code
1	RL78/F13	R5F10BBCKNA	PVQN0032KD-A
2	RL78/F13	R5F10BBCKXXXNA	PVQN0032KD-A
3	RL78/F13	R5F10BBCLNA	PVQN0032KD-A
4	RL78/F13	R5F10BBCLXXXNA	PVQN0032KD-A
5	RL78/F13	R5F10BBDKNA	PVQN0032KD-A
6	RL78/F13	R5F10BBDKXXXNA	PVQN0032KD-A
7	RL78/F13	R5F10BBDLNA	PVQN0032KD-A
8	RL78/F13	R5F10BBDLXXXNA	PVQN0032KD-A
9	RL78/F13	R5F10BBEKNA	PVQN0032KD-A
10	RL78/F13	R5F10BBEKXXXNA	PVQN0032KD-A
11	RL78/F13	R5F10BBELNA	PVQN0032KD-A
12	RL78/F13	R5F10BBELXXXNA	PVQN0032KD-A
13	RL78/F13	R5F10BBFKNA	PVQN0032KD-A
14	RL78/F13	R5F10BBFKXXXNA	PVQN0032KD-A
15	RL78/F13	R5F10BBFLNA	PVQN0032KD-A
16	RL78/F13	R5F10BBFLXXXNA	PVQN0032KD-A
17	RL78/F13	R5F10BBGKNA	PVQN0032KD-A
18	RL78/F13	R5F10BBGKXXXNA	PVQN0032KD-A
19	RL78/F13	R5F10BBGLNA	PVQN0032KD-A
20	RL78/F13	R5F10BBGLXXXNA	PVQN0032KD-A
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