

RENESAS SEMICONDUCTOR RELIABILITY REPORT

GROUP : RX231

DEVICE : R5F5231XXX

QUALITY GRADE : Standard

Quality Assurance Div.
Renesas Electronics Corporation

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
 2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
 3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
 4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
 5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
 6. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.
Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
 7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION ("Vulnerability Issues"). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
 8. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
 9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
 10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
 11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
 12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
 13. This document shall not be reproduced or duplicated in any form or disclosed to any third party, in whole or in part, without prior written consent of Renesas Electronics.
 14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.
- (Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
- (Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-2 October 2020)

Summary of Reliability Test Results for QFP Package (MSL3)

Test Item	Reference	Test Conditions	Results Failure/Size	Comment
High Temperature Operating Life (HTOL)	JESD22-A108	Ta=125 °C, Vccmax, 1000 hrs	0/231	3 lots or more
High Temperature Storage Life (HTSL)	JESD22-A103	Ta=150 °C, 1000 hrs	0/75	3 lots or more
Temperature Humidity bias (THB) (*1)	JESD22-A101	Ta=85 °C, RH=85 %, Vccmax, 1000 hrs	0/75	3 lots or more
Temperature Cycling (TC) (*1)	JESD22-A104	Ta=-65 °C to 150 °C , 500 cycles	0/75	3 lots or more
Latch-Up (LU)	JESD78	Pulse Current Injection, I=+/-150 mA	0/3	
Electrostatic discharge (ESD-HBM)	JS-001	1.5 kΩ, 100 pF, +/-2000 V, 1 time	0/3	Class: 2
Electrostatic discharge (ESD-CDM)	JEITA ED-4701/302	+/-1000 V, 1 time	0/3	Class: Equivalent to C2b
Solderability (SD)	J-STD-002	245 °C, 5 s, Solder coverage ≥95 %	0/5	
Resistance to Soldering Heat (MSL3)	JESD22-A113, J-STD-020	MSL3(Moisture Sensitivity Level 3) Peak Reflow Temp=260 °C	Pass	Verified after MSL preconditioning; applied to applicable reliability tests (*1).

Note :

- (*1) With preconditioning per JESD22-A113, MSL 3
- It is tested to confirm that all the samples are satisfied with an individual product specification.
- Basically qualification tests were performed using a representative product with the same wafer process and the same package structure .

Summary of Reliability Test Results for QFN Package (MSL3)

Test Item	Reference	Test Conditions	Results Failure/Size	Comment
High Temperature Operating Life (HTOL)	JESD22-A108	Ta=125 °C, Vccmax, 1000 hrs	0/231	3 lots or more
High Temperature Storage Life (HTSL)	JESD22-A103	Ta=150 °C, 1000 hrs	0/75	3 lots or more
Temperature Humidity bias (THB) (*1)	JESD22-A101	Ta=85 °C, RH=85 %, Vccmax, 1000 hrs	0/75	3 lots or more
Temperature Cycling (TC) (*1)	JESD22-A104	Ta=-65 °C to 150 °C , 500 cycles	0/75	3 lots or more
Latch-Up (LU)	JESD78	Pulse Current Injection, I=+/-150 mA	0/3	
Electrostatic discharge (ESD-HBM)	JS-001	1.5 kΩ, 100 pF, +/-2000 V, 1 time	0/3	Class: 2
Electrostatic discharge (ESD-CDM)	JEITA ED-4701/302	+/-1000 V,1 time	0/3	Class: Equivalent to C2b
Solderability (SD)	J-STD-002	245 °C, 5 s, Solder coverage ≥95 %	0/5	
Resistance to Soldering Heat (MSL3)	JESD22-A113, J-STD-020	MSL3(Moisture Sensitivity Level 3) Peak Reflow Temp=260 °C	Pass	Verified after MSL preconditioning; applied to applicable reliability tests (*1).

Note :

- (*1) With preconditioning per JESD22-A113, MSL 3
- It is tested to confirm that all the samples are satisfied with an individual product specification.
- Basically qualification tests were performed using a representative product with the same wafer process and the same package structure .

Summary of Reliability Test Results for LGA Package (MSL3)

Test Item	Reference	Test Conditions	Results Failure/Size	Comment
High Temperature Operating Life (HTOL)	JESD22-A108	Ta=125 °C, Vccmax, 1000 hrs	0/231	3 lots or more
High Temperature Storage Life (HTSL)	JESD22-A103	Ta=150 °C, 1000 hrs	0/75	3 lots or more
Temperature Humidity bias (THB) (*1)	JESD22-A101	Ta=85 °C, RH=85 %, Vccmax, 1000 hrs	0/75	3 lots or more
Temperature Cycling (TC) (*1)	JESD22-A104	Ta=-55 °C to 125 °C , 700 cycles	0/75	3 lots or more
Latch-Up (LU)	JESD78	Pulse Current Injection, I=+/-150 mA	0/3	
Electrostatic discharge (ESD-HBM)	JS-001	1.5 kΩ, 100 pF, +/-2000 V, 1 time	0/3	Class: 2
Electrostatic discharge (ESD-CDM)	JEITA ED-4701/302	+/-1000 V, 1 time	0/3	Class: Equivalent to C2b
Resistance to Soldering Heat (MSL3)	JESD22-A113, J-STD-020	MSL3(Moisture Sensitivity Level 3) Peak Reflow Temp=260 °C	Pass	Verified after MSL preconditioning; applied to applicable reliability tests (*1).

Note :

- (*1) With preconditioning per JESD22-A113, MSL 3
- It is tested to confirm that all the samples are satisfied with an individual product specification.
- Basically qualification tests were performed using a representative product with the same wafer process and the same package structure .

The failure rate of the device in an actual use condition can be estimated by the below procedure.

•Equation for the failure rate estimation (λ)

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

①Unique failure rate (λb)
 $\lambda b = 2.0 \text{ FIT}$
Unique failure rate at $T_a = 55 \text{ }^\circ\text{C}$ using 60 % confidence level.

②Temperature term (πT)
$$\pi T = \exp\{11600 \times E_a \times (1/(273+55) - 1/(273+T_a))\}$$

E_a : Activation energy (eV)
 T_a : Ambient temperature ($^\circ\text{C}$)

πT simplified chart as $E_a = 0.7 \text{ eV}$												
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

•MTTF (Mean Time To Failure)

$$MTTF = 1/\lambda$$

Reference about Renesas package code

Package type		Package code *1
Lead type plastic package	QFP	PxQP
	SOP	PxSP
Non-lead type plastic package	QFN	PxQN
Grid array type plastic package	BGA	PxBG
	LGA	PxLG
Wafer level chip scale package	WLCSP	SxBG

*1. First four digit

Table. Product list

No	Product part number	Package code	MSL	No	Product part number	Package code	MSL
1	R5F52315ADFL	PLQP0048K*	MSL3	51	R5F52316ADLA	PTLG0100K*	MSL3
2	R5F52315AGFL	PLQP0048K*	MSL3	52	R5F52316CDLA	PTLG0100K*	MSL3
3	R5F52315CDFL	PLQP0048K*	MSL3	53	R5F52317ADLA	PTLG0100K*	MSL3
4	R5F52315CGFL	PLQP0048K*	MSL3	54	R5F52317BDLA	PTLG0100K*	MSL3
5	R5F52316ADFL	PLQP0048K*	MSL3	55	R5F52318ADLA	PTLG0100K*	MSL3
6	R5F52316AGFL	PLQP0048K*	MSL3	56	R5F52318BDLA	PTLG0100K*	MSL3
7	R5F52316CDFL	PLQP0048K*	MSL3	57	R5F52315CDLF	PWLG0064K*	MSL3
8	R5F52316CGFL	PLQP0048K*	MSL3	58	R5F52316CDLF	PWLG0064K*	MSL3
9	R5F52317ADFL	PLQP0048K*	MSL3	59	R5F52315ADND	PWQN0064K*	MSL3
10	R5F52317AGFL	PLQP0048K*	MSL3	60	R5F52315AGND	PWQN0064K*	MSL3
11	R5F52317BDFL	PLQP0048K*	MSL3	61	R5F52315CDND	PWQN0064K*	MSL3
12	R5F52317BGFL	PLQP0048K*	MSL3	62	R5F52315CGND	PWQN0064K*	MSL3
13	R5F52318ADFL	PLQP0048K*	MSL3	63	R5F52316ADND	PWQN0064K*	MSL3
14	R5F52318AGFL	PLQP0048K*	MSL3	64	R5F52316AGND	PWQN0064K*	MSL3
15	R5F52318BDFL	PLQP0048K*	MSL3	65	R5F52316CDND	PWQN0064K*	MSL3
16	R5F52318BGFL	PLQP0048K*	MSL3	66	R5F52316CGND	PWQN0064K*	MSL3
17	R5F52315ADFM	PLQP0064K*	MSL3	67	R5F52317ADND	PWQN0064K*	MSL3
18	R5F52315AGFM	PLQP0064K*	MSL3	68	R5F52317AGND	PWQN0064K*	MSL3
19	R5F52315CDFM	PLQP0064K*	MSL3	69	R5F52317BDND	PWQN0064K*	MSL3
20	R5F52315CGFM	PLQP0064K*	MSL3	70	R5F52317BGND	PWQN0064K*	MSL3
21	R5F52316ADFM	PLQP0064K*	MSL3	71	R5F52318ADND	PWQN0064K*	MSL3
22	R5F52316AGFM	PLQP0064K*	MSL3	72	R5F52318AGND	PWQN0064K*	MSL3
23	R5F52316CDFM	PLQP0064K*	MSL3	73	R5F52318BDND	PWQN0064K*	MSL3
24	R5F52316CGFM	PLQP0064K*	MSL3	74	R5F52318BGND	PWQN0064K*	MSL3
25	R5F52317ADFM	PLQP0064K*	MSL3	75	R5F52315ADNE	PWQN0048K*	MSL3
26	R5F52317AGFM	PLQP0064K*	MSL3	76	R5F52315AGNE	PWQN0048K*	MSL3
27	R5F52317BDFM	PLQP0064K*	MSL3	77	R5F52315CDNE	PWQN0048K*	MSL3
28	R5F52317BGFM	PLQP0064K*	MSL3	78	R5F52315CGNE	PWQN0048K*	MSL3
29	R5F52318ADFM	PLQP0064K*	MSL3	79	R5F52316ADNE	PWQN0048K*	MSL3
30	R5F52318AGFM	PLQP0064K*	MSL3	80	R5F52316AGNE	PWQN0048K*	MSL3
31	R5F52318BDFM	PLQP0064K*	MSL3	81	R5F52316CDNE	PWQN0048K*	MSL3
32	R5F52318BGFM	PLQP0064K*	MSL3	82	R5F52316CGNE	PWQN0048K*	MSL3
33	R5F52315ADFP	PLQP0100K*	MSL3	83	R5F52317ADNE	PWQN0048K*	MSL3
34	R5F52315AGFP	PLQP0100K*	MSL3	84	R5F52317AGNE	PWQN0048K*	MSL3
35	R5F52315CDFP	PLQP0100K*	MSL3	85	R5F52317BDNE	PWQN0048K*	MSL3
36	R5F52315CGFP	PLQP0100K*	MSL3	86	R5F52317BGNE	PWQN0048K*	MSL3
37	R5F52316ADFP	PLQP0100K*	MSL3	87	R5F52318ADNE	PWQN0048K*	MSL3
38	R5F52316AGFP	PLQP0100K*	MSL3	88	R5F52318AGNE	PWQN0048K*	MSL3
39	R5F52316CDFP	PLQP0100K*	MSL3	89	R5F52318BDNE	PWQN0048K*	MSL3
40	R5F52316CGFP	PLQP0100K*	MSL3	90	R5F52318BGNE	PWQN0048K*	MSL3
41	R5F52317ADFP	PLQP0100K*	MSL3	91			
42	R5F52317AGFP	PLQP0100K*	MSL3	92			
43	R5F52317BDFP	PLQP0100K*	MSL3	93			
44	R5F52317BGFP	PLQP0100K*	MSL3	94			
45	R5F52318ADFP	PLQP0100K*	MSL3	95			
46	R5F52318AGFP	PLQP0100K*	MSL3	96			
47	R5F52318BDFP	PLQP0100K*	MSL3	97			
48	R5F52318BGFP	PLQP0100K*	MSL3	98			
49	R5F52315ADLA	PTLG0100K*	MSL3	99			
50	R5F52315CDLA	PTLG0100K*	MSL3	100			

Note: MSL stands for Moisture Sensitivity Level.