

Report No. MCR-21-0614

Date: 30/Jul./2021

# RENESAS SEMICONDUCTOR RELIABILITY REPORT

SERIES : RH850/F1L

DEVICE : R7F7010343AFP-C

APPLICATION : Automobile

Reliability & Failure Analysis Dept.  
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)

## Q100 Qualification Test Results for R7F7010343AFP-C

[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<br>(Fail of Total) | Comments:<br>(N/A =Not Applicable) |
|------|---|-----------|-----------------|------|------|-------|----------------------------|------------------------------------|
|------|---|-----------|-----------------|------|------|-------|----------------------------|------------------------------------|

### TEST GROUP A – ACCELERATED ENVIRONMENT STRESS TESTS

|                        |    |                          |                                                                                                                                |           |    |     |                                       |     |
|------------------------|----|--------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------|----|-----|---------------------------------------|-----|
| PC                     | A1 | JESD22 A113<br>J-STD-020 | Preconditioning: (Test @ Rm)<br>SMD only; Moisture Preconditioning for THB/HAST, AC/UHST, TC,<br>&PTC ; Peak Reflow Temp=260°C | Min.MSL=3 |    |     | MSL=3                                 | -   |
| THB<br>or<br>HAST      | A2 | JESD22 A101              | Temperature Humidity Bias: (Test @ Rm/Hot)<br>Ta=85°C, RH=85%, 1000hrs                                                         | 3         | 77 | 231 | 0 of 231                              | -   |
| AC or<br>UHST<br>or TH | A3 | JESD22 A118              | Unbiased Highly Accelerated Stree Test: (Test @ Rm)<br>110°C, 85% RH, 264h                                                     | 3         | 77 | 231 | 0 of 231                              | -   |
| TC                     | A4 | JESD22 A104              | Temperature Cycle: (Test @ Hot)<br>Ta=-65°C to 150°C, 500cyc                                                                   | 3         | 77 | 231 | 0 of 231<br>0 Fails after TC<br>(WBP) | -   |
| PTC                    | A5 | JESD22 A105              | Power Temperature Cycle: (Test @ Rm/Hot)<br>-                                                                                  | -         | -  | -   | -                                     | N/A |
| HTSL                   | A6 | JESD22 A103              | High Temperature Storage Life: (Test @ Rm/Hot)<br>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)<br>Ta=150°C, 1000hrs | 3        | 77  | 231  | 0 of 231  | -        |
| ELFR | B2 | AEC-Q100-008 | Early Life Failure Rate: (Test @ Rm/Hot)<br>Ta=125°C, 48hrs         | 3        | 800 | 2400 | 0 of 2400 | -        |
| EDR  | B3 | AEC-Q100-005 | NVM Endurance & Data Retention Test:<br>(Test @ Rm/Hot)             | For HTOL | 3   | 77   | 231       | 0 of 231 |
|      |    |              |                                                                     | For HTSL | 1   | 45   | 45        | 0 of 45  |

(C)RENESAS Electronics Corporation. All rights reserved.

| Test | # | Reference | Test Conditions | Lots | S.S. | Total | Results<br>(Fail of Total) | Comments:<br>(N/A =Not Applicable) |
|------|---|-----------|-----------------|------|------|-------|----------------------------|------------------------------------|
|------|---|-----------|-----------------|------|------|-------|----------------------------|------------------------------------|

**TEST GROUP C – PACKAGE ASSEMBLY INTEGRITY TESTS**

|     |    |                                         |                                                                                                    |             |                 |             |              |          |
|-----|----|-----------------------------------------|----------------------------------------------------------------------------------------------------|-------------|-----------------|-------------|--------------|----------|
| WBS | C1 | AEC-Q100-001<br>AEC-Q003                | Wire Bond Shear Test: (Cpk > 1.67)                                                                 | 30<br>bonds | 5 parts<br>Min. | 30<br>bonds | 0 of 30bonds | Cpk>1.67 |
| WBP | C2 | Mil-STD-883<br>Method 2011<br>AEC-Q003  | Wire Bond Pull: (Cpk > 1.67); Each bonder used                                                     | 30<br>bonds | 5 parts<br>Min. | 30<br>bonds | 0 of 30bonds | Cpk>1.67 |
| SD  | C3 | JESD22 B102<br>JSTD-002D                | Solderability: (>95% coverage)<br>8 hr steam aging prior to testing                                | 1           | 15              | 15          | 0 of 15      | -        |
| PD  | C4 | JESD22 B100,<br>JESD22 B108<br>AEC-Q003 | Physical Dimensions: (Cpk > 1.67)                                                                  | 3           | 10              | 30          | 0 of 30      | Cpk>1.67 |
| SBS | C5 | AEC-Q100-010<br>AEC-Q003                | Solder Ball Shear: (Cpk > 1.67); 5 balls from min. of 10 devices                                   | -           | -               | -           | -            | N/A      |
| LI  | C6 | JESD22 B105                             | Lead Integrity: (No lead cracking or breaking); Through-hole only; 10 leads from each of 5 devices | -           | -               | -           | -            | 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<br>(Fail of Total) | Comments:<br>(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  | E2  | AEC-Q100-002                     | Electrostatic Discharge, Human Body Model:<br>(Test @ Rm/Hot); (2KV HBM / Class 2 or better)                                       | 1   | 3   | 3   | 0 of 3<br>ESD Level=<br>HBM:2   | HBM>2KV                                                                                                                                                                  |
| CDM  | E3  | AEC-Q100-011                     | Electrostatic Discharge, Charged Device Model:<br>(Test @ Rm/Hot); (750V corner leads, 500V all other leads / Class C4B or better) | 1   | 3   | 3   | 0 of 3<br>ESD Level=<br>CDM:C4B | Corner leads: 750V Pass<br>All other leads:500V Pass                                                                                                                     |
| LU   | E4  | AEC-Q100-004                     | Latch-Up: (Test @ Rm/Hot)                                                                                                          | 1   | 6   | 6   | 0 of 6                          | -                                                                                                                                                                        |
| ED   | E5  | AEC-Q100-009<br>AEC-Q003         | Electrical Distributions: (Test @ Rm/Hot/Cold)<br>(where applicable, Cpk>1.67)                                                     | 3   | 30  | 90  | Cpk>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                                                                                                                                  |
| 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<br>JESD89-2<br>JESD89-3 | Soft Error Rate                                                                                                                    | 1   | 3   | 3   | Pass                            | -                                                                                                                                                                        |
| LF   | E12 | AEC-Q005                         | Lead (Pb) Free: (see AEC-Q005)                                                                                                     | -   | -   | -   | Pass                            | Solderability: See SD (C3) result. Solder heat resistance: N/A<br>(Wave Solder is Not recommended.) Whisker: Performed on product TEG with test method based on JESD201. |

| Test | # | Reference | Test Conditions | Lots | S.S. | Total | Results<br>(Fail of Total) | Comments:<br>(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)<br>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

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

· Calculation method of standard failure rate ( $\lambda$ )

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

(2) Temperature parameter

(1) Basic failure rate

(1) Basic failure rate ( $\lambda$ )

$$E_a : 0.7(\text{eV}) \quad \lambda_b : 0.0011 \quad (\text{FIT})$$

(2) Temperature parameter ( $\pi T$ )

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

$E_a$  : Activation energy(eV)

$T_a$  : ambient temperature

| $\pi T$ 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   |
| $\pi T$                                         | 0.31 | 0.68 | 1.00 | 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 )

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