

# **RENESAS SEMICONDUCTOR RELIABILITY REPORT**

GROUP : RX651  
DEVICE : R5F5651XXX  
APPLICATION : Consumer / Industry

Quality Assurance Div.  
Renesas Electronics Corporation

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**Table. Reliability test results (QFP)**

| Test Items                                | Reference                 | Test Conditions                      | Results<br>Failure/Size | Comment   |
|-------------------------------------------|---------------------------|--------------------------------------|-------------------------|-----------|
| High Temperature Operating Life<br>(HTOL) | JESD22-A108               | Ta=125 °C, Vccmax, 1000 hrs          | 0/22                    |           |
| High Temperature Storage Life<br>(HTSL)   | JESD22-A103               | Ta=150 °C, 1000 hrs                  | 0/22                    |           |
| Temperature Humidity bias<br>(THB) (*1)   | JESD22-A101               | Ta=85 °C, RH=85 %, Vccmax, 1000 hrs  | 0/22                    |           |
| Temperature Cycling<br>(TC) (*1)          | JESD22-A104               | Ta=-65 °C to 150 °C , 300 cycles     | 0/22                    |           |
| Latch-Up<br>(LU)                          | JESD78                    | Pulse Current Injection, I=+/-150 mA | 0/3                     |           |
| Electrostatic discharge<br>(ESD-HBM)      | JS-001                    | 1.5 kΩ, 100 pF, +/-2000 V, 1 time    | 0/3                     | Class: 2  |
| Electrostatic discharge<br>(ESD-CDM)      | JESD22-C101               | +/-500V,1time                        | 0/3                     | Class: C2 |
| Solderability<br>(SD)                     | J-STD-002                 | 245 °C, 5 s, Solder coverage ≥95 %   | 0/5                     |           |
| Resistance to Soldering Heat<br>(PC)      | JESD22-A113,<br>J-STD-020 | MSL3(Moisture Sensitivity Level 3)   | 0/22                    |           |

\*1) With preconditioning per JESD22-A113, MSL 3

•It is tested to confirm that all the samples are satisfied with an individual product specification.

Note :

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

**Table. Reliability test results (BGA)**

| Test Items                             | Reference              | Test Conditions                      | Results<br>Failure/Size | Comment   |
|----------------------------------------|------------------------|--------------------------------------|-------------------------|-----------|
| High Temperature Operating Life (HTOL) | JESD22-A108            | Ta=125 °C, Vccmax, 1000 hrs          | 0/22                    |           |
| High Temperature Storage Life (HTSL)   | JESD22-A103            | Ta=150 °C, 1000 hrs                  | 0/22                    |           |
| Temperature Humidity bias (THB) (*1)   | JESD22-A101            | Ta=85 °C, RH=85 %, Vccmax, 1000 hrs  | 0/22                    |           |
| Temperature Cycling (TC) (*1)          | JESD22-A104            | Ta=-55 °C to 125 °C , 500 cycles     | 0/22                    |           |
| 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)      | JESD22-C101            | +/-500V,1time                        | 0/3                     | Class: C2 |
| Resistance to Soldering Heat (PC)      | JESD22-A113, J-STD-020 | MSL3(Moisture Sensitivity Level 3)   | 0/22                    |           |

\*1) With preconditioning per JESD22-A113, MSL 3

•It is tested to confirm that all the samples are satisfied with an individual product specification.

Note :

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

**Table. Reliability test results (LGA)**

| Test Items                                | Reference                 | Test Conditions                      | Results<br>Failure/Size | Comment   |
|-------------------------------------------|---------------------------|--------------------------------------|-------------------------|-----------|
| High Temperature Operating Life<br>(HTOL) | JESD22-A108               | Ta=125 °C, Vccmax, 1000 hrs          | 0/22                    |           |
| High Temperature Storage Life<br>(HTSL)   | JESD22-A103               | Ta=150 °C, 1000 hrs                  | 0/22                    |           |
| Temperature Humidity bias<br>(THB) (*1)   | JESD22-A101               | Ta=85 °C, RH=85 %, Vccmax, 1000 hrs  | 0/22                    |           |
| Temperature Cycling<br>(TC) (*1)          | JESD22-A104               | Ta=-55 °C to 125 °C , 500 cycles     | 0/22                    |           |
| Latch-Up<br>(LU)                          | JESD78                    | Pulse Current Injection, I=+/-150 mA | 0/3                     |           |
| Electrostatic discharge<br>(ESD-HBM)      | JS-001                    | 1.5 kΩ, 100 pF, +/-2000 V, 1 time    | 0/3                     | Class: 2  |
| Electrostatic discharge<br>(ESD-CDM)      | JESD22-C101               | +/-500V,1time                        | 0/3                     | Class: C2 |
| Resistance to Soldering Heat<br>(PC)      | JESD22-A113,<br>J-STD-020 | MSL3(Moisture Sensitivity Level 3)   | 0/22                    |           |

\*1) With preconditioning per JESD22-A113, MSL 3

•It is tested to confirm that all the samples are satisfied with an individual product specification.

Note :

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 ( $\lambda$ )

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

①Unique failure rate ( $\lambda_b$ )

$$\lambda_b = 0.08 \text{ FIT}$$

Unique failure rate at  $T_a=55^\circ\text{C}$  using 60 % confidence level.

②Temperature term ( $\pi T$ )

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

$E_a$  : Activation energy (eV)

$T_a$  : Ambient temperature ( $^\circ\text{C}$ )

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

| $T_a$<br>( $^\circ\text{C}$ ) | 40   | 50   | 55 | 60   | 65   | 70   | 75   | 80   | 85   | 90    | 100   | 110   |
|-------------------------------|------|------|----|------|------|------|------|------|------|-------|-------|-------|
| $\pi T$                       | 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            |
| Non-lead type plastic package   | QFN | PxQN            |
| Grid array type plastic package | BGA | PxBG            |
|                                 | LGA | PxLG            |

\*1. First four digit

Table. Product list

| No | Group | Product part number | Package code | No  | Group | Product part number | Package code |
|----|-------|---------------------|--------------|-----|-------|---------------------|--------------|
| 1  | RX651 | R5F5651CDDBG        | PLBG0176G*   | 51  | RX651 | R5F56519FDFB        | PLQP0144K*   |
| 2  | RX651 | R5F5651CDGBG        | PLBG0176G*   | 52  | RX651 | R5F56519FGFB        | PLQP0144K*   |
| 3  | RX651 | R5F5651CHDBG        | PLBG0176G*   | 53  | RX651 | R5F5651CDDFB        | PLQP0144K*   |
| 4  | RX651 | R5F5651CHGBG        | PLBG0176G*   | 54  | RX651 | R5F5651CDGFB        | PLQP0144K*   |
| 5  | RX651 | R5F5651EDDBG        | PLBG0176G*   | 55  | RX651 | R5F5651CHDFB        | PLQP0144K*   |
| 6  | RX651 | R5F5651EDGBG        | PLBG0176G*   | 56  | RX651 | R5F5651CHGFB        | PLQP0144K*   |
| 7  | RX651 | R5F5651EHDBG        | PLBG0176G*   | 57  | RX651 | R5F5651EDDFB        | PLQP0144K*   |
| 8  | RX651 | R5F5651EHGBG        | PLBG0176G*   | 58  | RX651 | R5F5651EDGFB        | PLQP0144K*   |
| 9  | RX651 | R5F56514BDBP        | PTBG0064K*   | 59  | RX651 | R5F5651EHDFB        | PLQP0144K*   |
| 10 | RX651 | R5F56514BGBP        | PTBG0064K*   | 60  | RX651 | R5F5651EHGFB        | PLQP0144K*   |
| 11 | RX651 | R5F56514FDBP        | PTBG0064K*   | 61  | RX651 | R5F5651CDDFC        | PLQP0176K*   |
| 12 | RX651 | R5F56514FGBP        | PTBG0064K*   | 62  | RX651 | R5F5651CDGFC        | PLQP0176K*   |
| 13 | RX651 | R5F56517BDBP        | PTBG0064K*   | 63  | RX651 | R5F5651CHDFC        | PLQP0176K*   |
| 14 | RX651 | R5F56517BGBP        | PTBG0064K*   | 64  | RX651 | R5F5651CHGFC        | PLQP0176K*   |
| 15 | RX651 | R5F56517FDBP        | PTBG0064K*   | 65  | RX651 | R5F5651EDDFC        | PLQP0176K*   |
| 16 | RX651 | R5F56517FGBP        | PTBG0064K*   | 66  | RX651 | R5F5651EDGFC        | PLQP0176K*   |
| 17 | RX651 | R5F56519BDBP        | PTBG0064K*   | 67  | RX651 | R5F5651EHDFC        | PLQP0176K*   |
| 18 | RX651 | R5F56519BGBP        | PTBG0064K*   | 68  | RX651 | R5F5651EHGFC        | PLQP0176K*   |
| 19 | RX651 | R5F56519FDBP        | PTBG0064K*   | 69  | RX651 | R5F56514BDFM        | PLQP0064K*   |
| 20 | RX651 | R5F56519FGBP        | PTBG0064K*   | 70  | RX651 | R5F56514BGFM        | PLQP0064K*   |
| 21 | RX651 | R5F5651CDDBP        | PTBG0064K*   | 71  | RX651 | R5F56514FDFM        | PLQP0064K*   |
| 22 | RX651 | R5F5651CDGBP        | PTBG0064K*   | 72  | RX651 | R5F56514FGFM        | PLQP0064K*   |
| 23 | RX651 | R5F5651CHDBP        | PTBG0064K*   | 73  | RX651 | R5F56517BDFM        | PLQP0064K*   |
| 24 | RX651 | R5F5651CHGBP        | PTBG0064K*   | 74  | RX651 | R5F56517BGFM        | PLQP0064K*   |
| 25 | RX651 | R5F5651EDDBP        | PTBG0064K*   | 75  | RX651 | R5F56517FDFM        | PLQP0064K*   |
| 26 | RX651 | R5F5651EDGBP        | PTBG0064K*   | 76  | RX651 | R5F56517FGFM        | PLQP0064K*   |
| 27 | RX651 | R5F5651EHDBP        | PTBG0064K*   | 77  | RX651 | R5F56519BDFM        | PLQP0064K*   |
| 28 | RX651 | R5F5651EHGBP        | PTBG0064K*   | 78  | RX651 | R5F56519BGFM        | PLQP0064K*   |
| 29 | RX651 | R5F56514ADFB        | PLQP0144K*   | 79  | RX651 | R5F56519FDFM        | PLQP0064K*   |
| 30 | RX651 | R5F56514AGFB        | PLQP0144K*   | 80  | RX651 | R5F56519FGFM        | PLQP0064K*   |
| 31 | RX651 | R5F56514BDFB        | PLQP0144K*   | 81  | RX651 | R5F5651CDDFM        | PLQP0064K*   |
| 32 | RX651 | R5F56514BGFB        | PLQP0144K*   | 82  | RX651 | R5F5651CDGFM        | PLQP0064K*   |
| 33 | RX651 | R5F56514EDFB        | PLQP0144K*   | 83  | RX651 | R5F5651CHDFM        | PLQP0064K*   |
| 34 | RX651 | R5F56514EGFB        | PLQP0144K*   | 84  | RX651 | R5F5651CHGFM        | PLQP0064K*   |
| 35 | RX651 | R5F56514FDFB        | PLQP0144K*   | 85  | RX651 | R5F5651EDDFM        | PLQP0064K*   |
| 36 | RX651 | R5F56514FGFB        | PLQP0144K*   | 86  | RX651 | R5F5651EDGFM        | PLQP0064K*   |
| 37 | RX651 | R5F56517ADFB        | PLQP0144K*   | 87  | RX651 | R5F5651EHDFM        | PLQP0064K*   |
| 38 | RX651 | R5F56517AGFB        | PLQP0144K*   | 88  | RX651 | R5F5651EHGFM        | PLQP0064K*   |
| 39 | RX651 | R5F56517BDFB        | PLQP0144K*   | 89  | RX651 | R5F56514ADFP        | PLQP0100K*   |
| 40 | RX651 | R5F56517BGFB        | PLQP0144K*   | 90  | RX651 | R5F56514AGFP        | PLQP0100K*   |
| 41 | RX651 | R5F56517EDFB        | PLQP0144K*   | 91  | RX651 | R5F56514BDFP        | PLQP0100K*   |
| 42 | RX651 | R5F56517EGFB        | PLQP0144K*   | 92  | RX651 | R5F56514BGFP        | PLQP0100K*   |
| 43 | RX651 | R5F56517FDFB        | PLQP0144K*   | 93  | RX651 | R5F56514EDFP        | PLQP0100K*   |
| 44 | RX651 | R5F56517FGFB        | PLQP0144K*   | 94  | RX651 | R5F56514EGFP        | PLQP0100K*   |
| 45 | RX651 | R5F56519ADFB        | PLQP0144K*   | 95  | RX651 | R5F56514FDFP        | PLQP0100K*   |
| 46 | RX651 | R5F56519AGFB        | PLQP0144K*   | 96  | RX651 | R5F56514FGFP        | PLQP0100K*   |
| 47 | RX651 | R5F56519BDFB        | PLQP0144K*   | 97  | RX651 | R5F56517ADFP        | PLQP0100K*   |
| 48 | RX651 | R5F56519BGFB        | PLQP0144K*   | 98  | RX651 | R5F56517AGFP        | PLQP0100K*   |
| 49 | RX651 | R5F56519EDFB        | PLQP0144K*   | 99  | RX651 | R5F56517BDFP        | PLQP0100K*   |
| 50 | RX651 | R5F56519EGFB        | PLQP0144K*   | 100 | RX651 | R5F56517BGFP        | PLQP0100K*   |

Table. Product list

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| No  | Group | Product part number | Package code | No  | Group | Product part number | Package code |
|-----|-------|---------------------|--------------|-----|-------|---------------------|--------------|
| 101 | RX651 | R5F56517EDFP        | PLQP0100K*   | 161 | RX651 | R5F56514ADLK        | PTLG0145K*   |
| 102 | RX651 | R5F56517EGFP        | PLQP0100K*   | 162 | RX651 | R5F56514AGLK        | PTLG0145K*   |
| 103 | RX651 | R5F56517FDFP        | PLQP0100K*   | 163 | RX651 | R5F56514BDLK        | PTLG0145K*   |
| 104 | RX651 | R5F56517FGFP        | PLQP0100K*   | 164 | RX651 | R5F56514BGLK        | PTLG0145K*   |
| 105 | RX651 | R5F56519ADFP        | PLQP0100K*   | 165 | RX651 | R5F56514EDLK        | PTLG0145K*   |
| 106 | RX651 | R5F56519AGFP        | PLQP0100K*   | 166 | RX651 | R5F56514EGLK        | PTLG0145K*   |
| 107 | RX651 | R5F56519BDFP        | PLQP0100K*   | 167 | RX651 | R5F56514FDLK        | PTLG0145K*   |
| 108 | RX651 | R5F56519BGFP        | PLQP0100K*   | 168 | RX651 | R5F56514FGLK        | PTLG0145K*   |
| 109 | RX651 | R5F56519EDFP        | PLQP0100K*   | 169 | RX651 | R5F56517ADLK        | PTLG0145K*   |
| 110 | RX651 | R5F56519EGFP        | PLQP0100K*   | 170 | RX651 | R5F56517AGLK        | PTLG0145K*   |
| 111 | RX651 | R5F56519FDFP        | PLQP0100K*   | 171 | RX651 | R5F56517BDLK        | PTLG0145K*   |
| 112 | RX651 | R5F56519FGFP        | PLQP0100K*   | 172 | RX651 | R5F56517BGLK        | PTLG0145K*   |
| 113 | RX651 | R5F5651CDDFP        | PLQP0100K*   | 173 | RX651 | R5F56517EDLK        | PTLG0145K*   |
| 114 | RX651 | R5F5651CDGFP        | PLQP0100K*   | 174 | RX651 | R5F56517EGLK        | PTLG0145K*   |
| 115 | RX651 | R5F5651CHDFP        | PLQP0100K*   | 175 | RX651 | R5F56517FDLK        | PTLG0145K*   |
| 116 | RX651 | R5F5651CHGFP        | PLQP0100K*   | 176 | RX651 | R5F56517FGLK        | PTLG0145K*   |
| 117 | RX651 | R5F5651EDDFP        | PLQP0100K*   | 177 | RX651 | R5F56519ADLK        | PTLG0145K*   |
| 118 | RX651 | R5F5651EDGFP        | PLQP0100K*   | 178 | RX651 | R5F56519AGLK        | PTLG0145K*   |
| 119 | RX651 | R5F5651EHDFP        | PLQP0100K*   | 179 | RX651 | R5F56519BDLK        | PTLG0145K*   |
| 120 | RX651 | R5F5651EHGFP        | PLQP0100K*   | 180 | RX651 | R5F56519BGLK        | PTLG0145K*   |
| 121 | RX651 | R5F5651CDDLC        | PTLG0177K*   | 181 | RX651 | R5F56519EDLK        | PTLG0145K*   |
| 122 | RX651 | R5F5651CDGLC        | PTLG0177K*   | 182 | RX651 | R5F56519EGLK        | PTLG0145K*   |
| 123 | RX651 | R5F5651CHDLC        | PTLG0177K*   | 183 | RX651 | R5F56519FDLK        | PTLG0145K*   |
| 124 | RX651 | R5F5651CHGLC        | PTLG0177K*   | 184 | RX651 | R5F56519FGLK        | PTLG0145K*   |
| 125 | RX651 | R5F5651EDDLC        | PTLG0177K*   | 185 | RX651 | R5F5651CDDLK        | PTLG0145K*   |
| 126 | RX651 | R5F5651EDGLC        | PTLG0177K*   | 186 | RX651 | R5F5651CDGLK        | PTLG0145K*   |
| 127 | RX651 | R5F5651EHDLC        | PTLG0177K*   | 187 | RX651 | R5F5651CHDLK        | PTLG0145K*   |
| 128 | RX651 | R5F5651EHGLC        | PTLG0177K*   | 188 | RX651 | R5F5651CHGLK        | PTLG0145K*   |
| 129 | RX651 | R5F56514ADLJ        | PTLG0100J*   | 189 | RX651 | R5F5651EDDLK        | PTLG0145K*   |
| 130 | RX651 | R5F56514AGLJ        | PTLG0100J*   | 190 | RX651 | R5F5651EDGLK        | PTLG0145K*   |
| 131 | RX651 | R5F56514BDLJ        | PTLG0100J*   | 191 | RX651 | R5F5651EHDLK        | PTLG0145K*   |
| 132 | RX651 | R5F56514BGLJ        | PTLG0100J*   | 192 | RX651 | R5F5651EHGLK        | PTLG0145K*   |
| 133 | RX651 | R5F56514EDLJ        | PTLG0100J*   | 193 |       |                     |              |
| 134 | RX651 | R5F56514EGLJ        | PTLG0100J*   | 194 |       |                     |              |
| 135 | RX651 | R5F56514FDLJ        | PTLG0100J*   | 195 |       |                     |              |
| 136 | RX651 | R5F56514FGLJ        | PTLG0100J*   | 196 |       |                     |              |
| 137 | RX651 | R5F56517ADLJ        | PTLG0100J*   | 197 |       |                     |              |
| 138 | RX651 | R5F56517AGLJ        | PTLG0100J*   | 198 |       |                     |              |
| 139 | RX651 | R5F56517BDLJ        | PTLG0100J*   | 199 |       |                     |              |
| 140 | RX651 | R5F56517BGLJ        | PTLG0100J*   | 200 |       |                     |              |
| 141 | RX651 | R5F56517EDLJ        | PTLG0100J*   | 201 |       |                     |              |
| 142 | RX651 | R5F56517EGLJ        | PTLG0100J*   | 202 |       |                     |              |
| 143 | RX651 | R5F56517FDLJ        | PTLG0100J*   | 203 |       |                     |              |
| 144 | RX651 | R5F56517FGLJ        | PTLG0100J*   | 204 |       |                     |              |
| 145 | RX651 | R5F56519ADLJ        | PTLG0100J*   | 205 |       |                     |              |
| 146 | RX651 | R5F56519AGLJ        | PTLG0100J*   | 206 |       |                     |              |
| 147 | RX651 | R5F56519BDLJ        | PTLG0100J*   | 207 |       |                     |              |
| 148 | RX651 | R5F56519BGLJ        | PTLG0100J*   | 208 |       |                     |              |
| 149 | RX651 | R5F56519EDLJ        | PTLG0100J*   | 209 |       |                     |              |
| 150 | RX651 | R5F56519EGLJ        | PTLG0100J*   | 210 |       |                     |              |
| 151 | RX651 | R5F56519FDLJ        | PTLG0100J*   | 211 |       |                     |              |
| 152 | RX651 | R5F56519FGLJ        | PTLG0100J*   | 212 |       |                     |              |
| 153 | RX651 | R5F5651CDDLJ        | PTLG0100J*   | 213 |       |                     |              |
| 154 | RX651 | R5F5651CDGLJ        | PTLG0100J*   | 214 |       |                     |              |
| 155 | RX651 | R5F5651CHDLJ        | PTLG0100J*   | 215 |       |                     |              |
| 156 | RX651 | R5F5651CHGLJ        | PTLG0100J*   | 216 |       |                     |              |
| 157 | RX651 | R5F5651EDDLJ        | PTLG0100J*   | 217 |       |                     |              |
| 158 | RX651 | R5F5651EDGLJ        | PTLG0100J*   | 218 |       |                     |              |
| 159 | RX651 | R5F5651EHDLJ        | PTLG0100J*   | 219 |       |                     |              |
| 160 | RX651 | R5F5651EHGLJ        | PTLG0100J*   | 220 |       |                     |              |