RJF0611JPE
Silicon N Channel MOS FET Series
Power Switching

Description
This FET has the over temperature shut-down capability sensing to the junction temperature. This FET has the built-in over temperature shut-down circuit in the gate area. And this circuit operation to shut-down the gate voltage in case of high junction temperature like applying over power consumption, over current etc..

Features
- Logic level operation (4 V Gate drive).
- Built-in the over temperature shut-down circuit.
- High endurance capability against to the short circuit.
- Latch type shut down operation (need 0 voltage recovery).
- Built-in the current limitation circuit.
- Power supply voltage applies 12 V and 24 V.
- AEC-Q101 Compliant

Outline

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain to source voltage</td>
<td>$V_{DSS}$</td>
<td>60</td>
<td>V</td>
</tr>
<tr>
<td>Gate to source voltage</td>
<td>$V_{GSS}$</td>
<td>16</td>
<td>V</td>
</tr>
<tr>
<td>Gate to source voltage</td>
<td>$V_{GSS}$</td>
<td>-2.5</td>
<td>V</td>
</tr>
<tr>
<td>Drain current</td>
<td>$I_D$ Note 3</td>
<td>30</td>
<td>A</td>
</tr>
<tr>
<td>Body-drain diode reverse drain current</td>
<td>$I_{DR}$ Note 2</td>
<td>30</td>
<td>A</td>
</tr>
<tr>
<td>Avalanche current</td>
<td>$I_{AP}$ Note 3</td>
<td>6.7</td>
<td>A</td>
</tr>
<tr>
<td>Avalanche energy</td>
<td>$E_{AR}$ Note 2</td>
<td>192</td>
<td>mJ</td>
</tr>
<tr>
<td>Channel dissipation</td>
<td>$P_{ch}$ Note 1</td>
<td>50</td>
<td>W</td>
</tr>
<tr>
<td>Channel temperature</td>
<td>$T_{ch}$</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td>-55 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Notes:
1. Value at $T_c = 25^\circ C$
2. $T_{ch} = 25^\circ C$, $R_g \geq 50 \Omega$
3. It provides by the current limitation lower bound value.
### Typical Operation Characteristics

*(Ta = 25°C)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>$V_{IH}$</td>
<td>3.5</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>$V_i = 8, V, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$V_{IL}$</td>
<td>—</td>
<td>—</td>
<td>1.2</td>
<td>V</td>
<td>$V_i = 1.2, V, V_{DS} = 0$</td>
</tr>
<tr>
<td>Input current (Gate non shut down)</td>
<td>$I_{IH1}$</td>
<td>—</td>
<td>100</td>
<td>—</td>
<td>$\mu A$</td>
<td>$V_i = 8, V, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{IH2}$</td>
<td>—</td>
<td>50</td>
<td>—</td>
<td>$\mu A$</td>
<td>$V_i = 3.5, V, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{IL}$</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>$\mu A$</td>
<td>$V_i = 3.5, V, V_{DS} = 0$</td>
</tr>
<tr>
<td>Input current (Gate shut down)</td>
<td>$I_{IH(sd)1}$</td>
<td>—</td>
<td>0.8</td>
<td>—</td>
<td>mA</td>
<td>$V_i = 8, V, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{IH(sd)2}$</td>
<td>—</td>
<td>0.35</td>
<td>—</td>
<td>mA</td>
<td>$V_i = 3.5, V, V_{DS} = 0$</td>
</tr>
<tr>
<td>Shut down temperature</td>
<td>$T_{sd}$</td>
<td>—</td>
<td>175</td>
<td>—</td>
<td>°C</td>
<td>Channel temperature</td>
</tr>
<tr>
<td>Gate operation voltage</td>
<td>$V_{OP}$</td>
<td>3.5</td>
<td>—</td>
<td>12</td>
<td>V</td>
<td>$V_{GS} = 5, V, V_{DS} = 0$</td>
</tr>
<tr>
<td>Drain current (Current limitation value)</td>
<td>$I_{D\text{ limit}}$</td>
<td>30</td>
<td>—</td>
<td>—</td>
<td>A</td>
<td>$V_{GS} = 5, V, V_{DS} = 10, V$<em>(Note 4)</em></td>
</tr>
</tbody>
</table>

**Note:** 4. Pulse test

### Electrical Characteristics

*(Ta = 25°C)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain current</td>
<td>$I_{D1}$</td>
<td>—</td>
<td>—</td>
<td>45</td>
<td>A</td>
<td>$V_{GS} = 3.5, V, V_{DS} = 10, V$</td>
</tr>
<tr>
<td></td>
<td>$I_{D2}$</td>
<td>—</td>
<td>—</td>
<td>10</td>
<td>mA</td>
<td>$V_{GS} = 1.2, V, V_{DS} = 10, V$</td>
</tr>
<tr>
<td></td>
<td>$I_{D3}$</td>
<td>30</td>
<td>—</td>
<td>—</td>
<td>A</td>
<td>$V_{GS} = 5, V, V_{DS} = 10, V$<em>(Note 5)</em></td>
</tr>
<tr>
<td>Drain to source breakdown voltage</td>
<td>$V_{(BR)DSS}$</td>
<td>60</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>$I_D = 10, mA, V_{GS} = 0$</td>
</tr>
<tr>
<td>Gate to source breakdown voltage</td>
<td>$V_{BRGSS}$</td>
<td>16</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>$I_D = 800, \mu A, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$V_{IR(s2)}$</td>
<td>—</td>
<td>—</td>
<td>2.5</td>
<td>V</td>
<td>$I_D = -100, \mu A, V_{DS} = 0$</td>
</tr>
<tr>
<td>Gate to source leak current</td>
<td>$I_{GS1}$</td>
<td>—</td>
<td>—</td>
<td>100</td>
<td>$\mu A$</td>
<td>$V_{GS} = 8, V, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{GS2}$</td>
<td>—</td>
<td>—</td>
<td>50</td>
<td>$\mu A$</td>
<td>$V_{GS} = 3.5, V, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{GS3}$</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>$\mu A$</td>
<td>$V_{GS} = 1.2, V, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{GS4}$</td>
<td>—</td>
<td>—</td>
<td>-100</td>
<td>$\mu A$</td>
<td>$V_{GS} = -2.4, V, V_{DS} = 0$</td>
</tr>
<tr>
<td>Input current (shut down)</td>
<td>$I_{GS(OP1)}$</td>
<td>—</td>
<td>0.8</td>
<td>—</td>
<td>mA</td>
<td>$V_{GS} = 8, V, V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{GS(OP2)}$</td>
<td>—</td>
<td>0.35</td>
<td>—</td>
<td>mA</td>
<td>$V_{GS} = 3.5, V, V_{DS} = 0$</td>
</tr>
<tr>
<td>Zero gate voltage drain current</td>
<td>$I_{DSS}$</td>
<td>—</td>
<td>—</td>
<td>10</td>
<td>$\mu A$</td>
<td>$V_{DS} = 32, V, V_{GS} = 0, T_c = 110, ^°C$</td>
</tr>
<tr>
<td>Gate to source cutoff voltage</td>
<td>$V_{GS(off)}$</td>
<td>1.1</td>
<td>—</td>
<td>2.1</td>
<td>V</td>
<td>$V_{DS} = 10, V, I_{D} = 1, mA$</td>
</tr>
<tr>
<td>Forward transfer admittance</td>
<td>$</td>
<td>y_{fs}</td>
<td>$</td>
<td>12</td>
<td>27</td>
<td>—</td>
</tr>
<tr>
<td>Static drain to source on state resistance</td>
<td>$R_{DS(on)}$</td>
<td>—</td>
<td>30</td>
<td>40</td>
<td>$\text{m} \Omega$</td>
<td>$I_D = 15, A, V_{GS} = 4, V$<em>(Note 5)</em></td>
</tr>
<tr>
<td></td>
<td>$R_{DS(on)}$</td>
<td>—</td>
<td>21</td>
<td>30</td>
<td>$\text{m} \Omega$</td>
<td>$I_D = 15, A, V_{GS} = 10, V$<em>(Note 5)</em></td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
<td>—</td>
<td>523</td>
<td>—</td>
<td>$\text{p} \Omega$</td>
<td>$V_{DS} = 10, V, V_{GS} = 0, f = 1, \text{MHz}$</td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{(on)}$</td>
<td>—</td>
<td>3.8</td>
<td>—</td>
<td>$\mu s$</td>
<td>$V_{GS} = 10, V, I_{D} = 15, A, R_L = 2, \Omega$</td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_r$</td>
<td>—</td>
<td>13.5</td>
<td>—</td>
<td>$\mu s$</td>
<td></td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{(off)}$</td>
<td>—</td>
<td>4.1</td>
<td>—</td>
<td>$\mu s$</td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_f$</td>
<td>—</td>
<td>7.3</td>
<td>—</td>
<td>$\mu s$</td>
<td></td>
</tr>
<tr>
<td>Body-drain diode forward voltage</td>
<td>$V_{DF}$</td>
<td>—</td>
<td>0.9</td>
<td>—</td>
<td>V</td>
<td>$I_D = 30, A, V_{GS} = 0$</td>
</tr>
<tr>
<td>Body-drain diode reverse recovery time</td>
<td>$t_{rr}$</td>
<td>—</td>
<td>110</td>
<td>—</td>
<td>ns</td>
<td>$I_D = 30, A, V_{GS} = 0$</td>
</tr>
<tr>
<td>Over load shut down operation time <em>(Note 6)</em></td>
<td>$t_{os1}$</td>
<td>—</td>
<td>0.34</td>
<td>—</td>
<td>ms</td>
<td>$V_{GS} = 5, V, V_{DD} = 16, V$</td>
</tr>
<tr>
<td></td>
<td>$t_{os2}$</td>
<td>—</td>
<td>0.23</td>
<td>—</td>
<td>ms</td>
<td>$V_{GS} = 5, V, V_{DD} = 24, V$</td>
</tr>
</tbody>
</table>

**Notes:**
5. Pulse test
6. Including the junction temperature rise of the over loaded condition.
Main Characteristics

- **Power vs. Temperature Derating**
- **Maximum Safe Operation Area**
- **Typical Output Characteristics**
- **Typical Transfer Characteristics**
- **Drain to Source Saturation Voltage vs. Gate to Source Voltage**
- **Static Drain to Source on State Resistance vs. Drain Current**
Switching Time Test Circuit

Vin Monitor

D.U.T.

Rg

RL

VDD

$V_{DD} = 30 \text{ V}$

Vout Monitor

Vin

10 V

50 Ω

Waveform

Vout

$10\%$

$90\%$

$t_d(on)$

$t_f$

$t_d(off)$

10%

90%

VDD

Monitor

Vin

10 V

50 Ω

Avalanche Test Circuit

VDS Monitor

Rg

L

IAP Monitor

D.U.T

VDD

VDD

0

VDD

Avalanche Waveform

$E_{AR} = \frac{1}{2} L \cdot I_{AP}^2 \cdot \frac{V_{BR\cdot DSS}}{V_{BR\cdot DSS} - V_{DD}}$

IAP

VBR\cdot DSS

VDS

Vin

10 V

50 Ω

Vout Monitor

$90\%$

$10\%$

$t_f$

$90\%$

$t_d(on)$
### Package Dimensions

<table>
<thead>
<tr>
<th>Package Name</th>
<th>JETTA Package Code</th>
<th>RENESAS Code</th>
<th>Previous Code</th>
<th>MASS[Typ.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDPA0611JPE</td>
<td>SC-BD</td>
<td>PPR3009A6E-B</td>
<td>PPR3009A6E-B</td>
<td>1.30g</td>
</tr>
</tbody>
</table>

**Unit: mm**

![Package Dimensions Diagram]

### Ordering Information

<table>
<thead>
<tr>
<th>Orderable Part Number</th>
<th>Quantity</th>
<th>Shipping Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJF0611JPE-00-J3</td>
<td>1000 pcs</td>
<td>Taping</td>
</tr>
</tbody>
</table>

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