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 (3 V Gate drive).
- Built-in the over temperature shut-down circuit.
- High endurance capability against to the short circuit.
- Hysteresis type shut down operation.
- High density mounting.
- Built-in the current limitation circuit.
- Power supply voltage applies 12 V.
- AEC-Q101compliant.

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>$I_D$</td>
<td>–1.5</td>
<td>A</td>
</tr>
<tr>
<td>Body-drain diode reverse drain current</td>
<td>$I_{BR}$</td>
<td>–1.5</td>
<td>A</td>
</tr>
<tr>
<td>Avalanche current</td>
<td>$I_{AP}$</td>
<td>–1.5</td>
<td>A</td>
</tr>
<tr>
<td>Avalanche energy</td>
<td>$E_{AR}$</td>
<td>9.6</td>
<td>mJ</td>
</tr>
<tr>
<td>Channel dissipation</td>
<td>$P_{ch}$</td>
<td>1</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. When using the glass epoxy board (FR4 40 × 40 × 1.6 mm), PW ≤ 10 s
2. $T_{ch} = 25°C$, $R_g ≥ 50$ Ω
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</td>
<td></td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{IL}$</td>
<td></td>
<td></td>
<td>–1.2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input current (Gate non shut down)</td>
<td>$I_{IH1}$</td>
<td></td>
<td></td>
<td>–100</td>
<td>µA</td>
<td>$V_i = –8 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{IH2}$</td>
<td></td>
<td></td>
<td>–50</td>
<td>µA</td>
<td>$V_i = –3.5 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{IL}$</td>
<td></td>
<td></td>
<td>–10</td>
<td>µA</td>
<td>$V_i = –1.2 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td>Input current (Gate shut down)</td>
<td>$I_{IHSD1}$</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>$I_{IHSD2}$</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></td>
<td>175</td>
<td>°C</td>
<td>Channel temperature</td>
</tr>
<tr>
<td>Return temperature</td>
<td>$T_{hr}$</td>
<td></td>
<td></td>
<td>105</td>
<td>°C</td>
<td>Channel temperature</td>
</tr>
<tr>
<td>Gate operation voltage</td>
<td>$V_{op}$</td>
<td>–3</td>
<td></td>
<td>–12</td>
<td>V</td>
<td>$V_{GS} = –12 , V, , V_{DS} = –10 , V$ Note 4</td>
</tr>
</tbody>
</table>

#### Notes:
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>$I_{D}$</td>
<td>–1.5</td>
<td></td>
<td>–12</td>
<td>A</td>
<td>$V_{GS} = –3.5 , V, , V_{DS} = –10 , V$ Note 5</td>
</tr>
<tr>
<td></td>
<td>$I_{D}$</td>
<td></td>
<td>–40</td>
<td></td>
<td>mA</td>
<td>$V_{GS} = –1.2 , V, , V_{DS} = –10 , V$</td>
</tr>
<tr>
<td></td>
<td>$I_{D}$</td>
<td>–1.5</td>
<td></td>
<td></td>
<td>A</td>
<td>$V_{GS} = –12 , V, , V_{DS} = –10 , V$ Note 5</td>
</tr>
<tr>
<td></td>
<td>$I_{D}$</td>
<td>–0.8</td>
<td></td>
<td></td>
<td>A</td>
<td>$V_{GS} = –3 , V, , V_{DS} = –10 , V$ Note 5</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>$V_{(BR)GSS}$</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>$V_{(BR)GSS}$</td>
<td>2.5</td>
<td></td>
<td></td>
<td>V</td>
<td>$I_{D} = 100 , \mu A, , V_{DS} = 0$</td>
</tr>
<tr>
<td>Gate to source leak current</td>
<td>$I_{DSS}$</td>
<td></td>
<td></td>
<td>–100</td>
<td>µA</td>
<td>$V_{GS} = –8 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{DSS}$</td>
<td></td>
<td></td>
<td>–50</td>
<td>µA</td>
<td>$V_{GS} = –3.5 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{DSS}$</td>
<td></td>
<td></td>
<td>–10</td>
<td>µA</td>
<td>$V_{GS} = –1.2 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{DSS}$</td>
<td></td>
<td></td>
<td>100</td>
<td>µA</td>
<td>$V_{GS} = 2.4 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td>Input current (shut down)</td>
<td>$I_{DSS(OP)}$</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>$I_{DSS(OP)}$</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>$I_{oss}$</td>
<td></td>
<td></td>
<td>–10</td>
<td>µA</td>
<td>$V_{GS} = –48 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{oss}$</td>
<td></td>
<td></td>
<td>–10</td>
<td>µA</td>
<td>$V_{GS} = –48 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td></td>
<td>$I_{oss}$</td>
<td></td>
<td></td>
<td>100</td>
<td>µA</td>
<td>$V_{GS} = 2.4 , V, , V_{DS} = 0$</td>
</tr>
<tr>
<td>Gate to source cutoff voltage</td>
<td>$V_{GS(off)}$</td>
<td>–0.9</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>1.5</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>Static drain to source on state resistance</td>
<td>$R_{D(on)}$</td>
<td>445</td>
<td>800</td>
<td></td>
<td>mΩ</td>
<td>$I_{D} = –0.4 , A, , V_{GS} = –3 , V$ Note 5</td>
</tr>
<tr>
<td></td>
<td>$R_{D(on)}$</td>
<td>363</td>
<td>425</td>
<td></td>
<td>mΩ</td>
<td>$I_{D} = –0.75 , A, , V_{GS} = –4 , V$ Note 5</td>
</tr>
<tr>
<td></td>
<td>$R_{D(on)}$</td>
<td>272</td>
<td>350</td>
<td></td>
<td>mΩ</td>
<td>$I_{D} = –0.75 , A, , V_{GS} = –10 , V$ Note 5</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
<td></td>
<td></td>
<td>213</td>
<td>pF</td>
<td>$V_{DS} = –10 , V, , V_{GS} = 0$, f = 1MHz</td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{(on)}$</td>
<td></td>
<td>0.9</td>
<td></td>
<td>µs</td>
<td>$V_{GS} = –10 , V, , I_{D} = –0.75 , A$, $R_{L} = 40 , \Omega$</td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_{r}$</td>
<td></td>
<td>3.4</td>
<td></td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{(off)}$</td>
<td></td>
<td>3.2</td>
<td></td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
<td></td>
<td>6.3</td>
<td></td>
<td>µs</td>
<td></td>
</tr>
<tr>
<td>Body-drain diode forward voltage</td>
<td>$V_{DF}$</td>
<td></td>
<td>–0.8</td>
<td></td>
<td>V</td>
<td>$I_{F} = –1.5 , A, , V_{GS} = 0$</td>
</tr>
<tr>
<td>Body-drain diode reverse recovery time</td>
<td>$t_{rr}$</td>
<td></td>
<td>70</td>
<td></td>
<td>ns</td>
<td>$I_{F} = –1.5 , A, , V_{GS} = 0$, $di/dt = 50 , A/\mu s$</td>
</tr>
<tr>
<td>Over load shut down operation time Note 6</td>
<td>$t_{os}$</td>
<td></td>
<td>5.4</td>
<td></td>
<td>ms</td>
<td>$V_{GS} = –5 , V, , V_{DD} = –16 , V$</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

- Ambient Temperature $T_a$ ($^\circ$C)
- Channel Dissipation $P_{ch}$ (W)

Maximum Safe Operation Area

- Drain to Source Voltage $V_{DS}$ (V)
- Drain Current $I_D$ (A)

Typical Output Characteristics

- Drain Current $I_D$ (A)
- Drain to Source Voltage $V_{DS}$ (V)

Static Drain to Source On State Resistance

- Gate to Source Voltage $V_{GS}$ (V)
- Static Drain to Source On State Resistance $R_{DS(on)}$ (mW)

Typical Transfer Characteristics

- Gate to Source Voltage $V_{GS}$ (V)
- Drain Current $I_D$ (A)

Drain Source Saturation Voltage vs. Gate to Source Voltage

- Drain Source Saturation Voltage $V_{DS(on)}$ (mV)
- Gate to Source Voltage $V_{GS}$ (V)

Note 7:
When using the glass epoxy board.
(FR4 40 x 40 x 1.6 mm)
Static Drain to Source On State Resistance vs. Temperature

Switching Characteristics

Reverse Drain Current vs. Source to Drain Voltage

Gate to Source Voltage vs. Shutdown Time of Load-Short Test

Body-Drain Diode Reverse Recovery Time

Typical Capacitance vs. Drain to Source Voltage

Static Drain to Source On State Resistance (mΩ)

Reverse Drain Current IDR (A)

Capacitance C (pF)

Reverse Recovery Time trr (ns)

Source to Drain Voltage VSD (V)

Gate to Source Voltage vs. Shutdown Time of Load-Short Test

Pulse Test

VGS = 0

r = 1 MHz

VGS = 0

VGS = −3 V

ID = −1.5 A

VGS = −10 V, VDD = −30 V

PW = 300 μs, duty ≤ 1%

VDD = −16 V

Source to Drain Voltage VSD (V)

Shutdown Time of Load-Short Test Pw (ms)

VGS = −10 V

VDD = −30 V

PW = 300 μs, duty ≤ 1%

VDD = −16 V

VGS = 0

VGS = −10 V

VDD = −30 V

PW = 300 μs, duty ≤ 1%
When using the glass epoxy board (FR4 40 x 40 x 1.6 mm)

\[ \theta_{ch-f} = \gamma_s(t) \cdot \theta_{ch-f} \]

\[ \theta_{ch-f} = 125^\circ C/W, \ Ta = 25^\circ C \]

When using the glass epoxy board (FR4 40 x 40 x 1.6 mm)

\[ D = \frac{PW}{T} \]

\[ \text{Pulse Width} = PW \]

\[ \text{Normalized Transient Thermal Impedance} = \gamma_s(t) \]

\[ \text{Gate to Source Voltage} = V_{GS} (V) \]

\[ \text{Shutdown Case Temperature} = T_c (\circ C) \]

\[ \text{Gate to Source Voltage} = V_{DS} = -10 \text{ V} \]

\[ \text{Pulse Test} \]

\[ \text{Normalized Transient Thermal Impedance vs. Pulse Width} \]

\[ \text{Forward transfer admittance vs. Drain Current} \]

\[ \text{Shutdown Case Temperature vs. Gate to Source Voltage} \]
**Switching Time Test Circuit**

- **Vin Monitor**
- **Vout Monitor**
- **D.U.T.**
- **Rg**
- **RL**
- **VDD** = -30 V
- **Vin** = -10 V

**Waveform**

- **Vin**
- **Vout**
- **Id(on)**
- **Id(off)**

**Avalanche Test Circuit**

- **VDD Monitor**
- **L**
- **IAP Monitor**
- **D. U. T.**
- **Rg**
- **50 Ω**
- **Vin** = -10 V

**Avalanche Waveform**

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

- **VDD**
- **VDS**
- **VBR,DSS**
**Package Dimensions**

<table>
<thead>
<tr>
<th>Package Name</th>
<th>JEITA Package Code</th>
<th>RENESAS Code</th>
<th>Previous Code</th>
<th>MASS[Typ.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOP-8</td>
<td>P-SOP8-3.95/4.9/1.27</td>
<td>PRSPR003DD-D</td>
<td>FF-80AXV</td>
<td>0.055g</td>
</tr>
</tbody>
</table>

**Ordering Information**

<table>
<thead>
<tr>
<th>Orderable Part Number</th>
<th>Quantity</th>
<th>Shipping Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJE0623JSP-00-J0</td>
<td>2500 pcs/reel</td>
<td>Taping</td>
</tr>
</tbody>
</table>

Note: The symbol of 2nd'-' is occasionally presented as "#".
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Colophon 8.0