**RJK0651DPB**

60V, 25A, 14mΩ max.
Silicon N Channel Power MOS FET
Power Switching

**Features**

- High speed switching
- Capable of 4.5 V gate drive
- Low drive current
- High density mounting

- Low on-resistance
  \[ R_{DS(on)} = 11 \text{ m}\Omega \text{ typ. (at } V_{GS} = 10 \text{ V)} \]
- Pb-free
- Halogen-free

**Outline**

RENEAS Package code: PTZZ0005DA-A
(Package name: LFPAK)

**Application**

- Switching Mode Power Supply

**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>±20</td>
<td>V</td>
</tr>
<tr>
<td>Drain current</td>
<td>( I_D )</td>
<td>25</td>
<td>A</td>
</tr>
<tr>
<td>Drain peak current</td>
<td>( I_{D(pulse)}^{\text{Note1}} )</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>Body-drain diode reverse drain current</td>
<td>( I_{DR} )</td>
<td>25</td>
<td>A</td>
</tr>
<tr>
<td>Avalanche current</td>
<td>( I_{AP}^{\text{Note2}} )</td>
<td>12.5</td>
<td>A</td>
</tr>
<tr>
<td>Avalanche energy</td>
<td>( E_{AS}^{\text{Note2}} )</td>
<td>11.7</td>
<td>mJ</td>
</tr>
<tr>
<td>Channel dissipation</td>
<td>( P_{ch}^{\text{Note3}} )</td>
<td>45</td>
<td>W</td>
</tr>
<tr>
<td>Channel to Case Thermal Resistance</td>
<td>( \theta_{ch-C} )</td>
<td>2.78</td>
<td>°C/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. \( PW \leq 10 \mu s, \text{ duty cycle } \leq 1\% \)
2. Value at \( T_{ch} = 25^\circ \text{C}, R_g \geq 50 \Omega \)
3. \( T_c = 25^\circ \text{C} \)

This product is for the low voltage drive (\( \leq 10 \text{V} \)).
If the driving voltage is over 10 V under normal conditions, please use the product for high gate to source cutoff voltage \( (V_{GSS(on)}) \) which characteristics has been improved.
## 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 to source breakdown voltage</td>
<td>$V_{BRDSS}$</td>
<td>60</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>$I_D = 10$ mA, $V_{GS} = 0$ V</td>
</tr>
<tr>
<td>Gate to source leak current</td>
<td>$I_{GS}$</td>
<td>—</td>
<td>—</td>
<td>±0.1</td>
<td>$\mu$A</td>
<td>$V_{GS} = \pm 20$ V, $V_{DS} = 0$ V</td>
</tr>
<tr>
<td>Zero gate voltage drain current</td>
<td>$I_{DSS}$</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>$\mu$A</td>
<td>$V_{DS} = 60$ V, $V_{GS} = 0$ V</td>
</tr>
<tr>
<td>Gate to source cutoff voltage</td>
<td>$V_{GS(off)}$</td>
<td>1.2</td>
<td>—</td>
<td>2.5</td>
<td>V</td>
<td>$V_{DS} = 10$ V, $I_D = 1$ mA</td>
</tr>
<tr>
<td>Static drain to source on state resistance</td>
<td>$R_{DS(on)}$</td>
<td>—</td>
<td>11</td>
<td>14</td>
<td>$m\Omega$</td>
<td>$I_D = 12.5$ A, $V_{GS} = 10$ V $^{Note4}$</td>
</tr>
<tr>
<td></td>
<td>$R_{DS(on)}$</td>
<td>13</td>
<td>18</td>
<td></td>
<td>$m\Omega$</td>
<td>$I_D = 12.5$ A, $V_{GS} = 4.5$ V $^{Note4}$</td>
</tr>
<tr>
<td>Forward transfer admittance</td>
<td>$</td>
<td>Y_{H}</td>
<td>$</td>
<td>—</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{iss}$</td>
<td>—</td>
<td>2030</td>
<td>—</td>
<td>pF</td>
<td>$V_{DS} = 10$ V, $V_{GS} = 0$ V, $f = 1$ MHz</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
<td>—</td>
<td>250</td>
<td>—</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rss}$</td>
<td>—</td>
<td>100</td>
<td>—</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>Gate Resistance</td>
<td>$R_g$</td>
<td>—</td>
<td>0.7</td>
<td>—</td>
<td>$\Omega$</td>
<td></td>
</tr>
<tr>
<td>Total gate charge</td>
<td>$Q_g$</td>
<td>—</td>
<td>15</td>
<td>—</td>
<td>nC</td>
<td>$V_{DD} = 25$ V, $V_{GS} = 4.5$ V, $I_D = 25$ A</td>
</tr>
<tr>
<td>Gate to source charge</td>
<td>$Q_{gs}$</td>
<td>—</td>
<td>6.7</td>
<td>—</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>Gate to drain charge</td>
<td>$Q_{gd}$</td>
<td>—</td>
<td>3.7</td>
<td>—</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>$t_{d(on)}$</td>
<td>—</td>
<td>8.4</td>
<td>—</td>
<td>ns</td>
<td>$V_{GS} = 10$ V, $I_D = 12.5$ A, $V_{DD} = 30$ V, $R_L = 2.4$ $\Omega$, $R_g = 4.7$ $\Omega$</td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_r$</td>
<td>—</td>
<td>4.4</td>
<td>—</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{d(off)}$</td>
<td>—</td>
<td>42</td>
<td>—</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_f$</td>
<td>—</td>
<td>6.8</td>
<td>—</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Body–drain diode forward voltage</td>
<td>$V_{DF}$</td>
<td>—</td>
<td>0.83</td>
<td>1.1</td>
<td>V</td>
<td>$I_F = 25$ A, $V_{GS} = 0$ V $^{Note4}$</td>
</tr>
<tr>
<td>Body–drain diode reverse recovery time</td>
<td>$t_{tr}$</td>
<td>—</td>
<td>32</td>
<td>—</td>
<td>ns</td>
<td>$I_F = 25$ A, $V_{GS} = 0$ V $di/dt = 100$ A/$\mu$S</td>
</tr>
</tbody>
</table>

Notes: 4. Pulse test
Main Characteristics

- **Drain to Source Voltage** \( V_{DS} \) (V)
- **Drain Current** \( I_D \) (A)
- **Gate to Source Voltage** \( V_{GS} \) (V)
- **Drain to Source Saturation Voltage vs. Gate to Source Voltage**
- **Drain to Source Saturation Voltage** \( V_{DS\,(on)} \) (mV)
- **Drain Current vs. Drain Current**
- **Static Drain to Source on State Resistance vs. Drain Current**
- **Power vs. Temperature Derating**
- **Maximum Safe Operation Area**
- **Channel Dissipation** \( P_{ch} \) (W)
- **Case Temperature** \( T_c \) (°C)
- **Power vs. Temperature Derating**
- **Maximum Safe Operation Area**
- **DC Operation**
- **Operation in this area is limited by \( R_{DS\,(on)} \)**
- **1 shot Pulse**
- **PW = 10 ms**
- **Operation in this area is limited by \( R_{DS\,(on)} \)**
Case Temperature $T_c$ (°C)

Static Drain to Source on State Resistance vs. Temperature

- $V_{GS} = 4.5$ V
- $V_{GS} = 10$ V

Channel Temperature $T_{ch}$ (°C)

Avalanche Energy $E_{AS}$ (mJ)

Maximum Avalanche Energy vs. Channel Temperature Derating

- $I_{AP} = 12.5$ A
- $V_{DD} = 20$ V
- duty < 0.1 %
- $R_g \geq 50$ Ω

Source to Drain Voltage $V_{SD}$ (V)

Gate Charge $Q_g$ (nC)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Typical Capacitance vs. Drain to Source Voltage

- $I_{DR}$
- $C_{iss}$
- $C_{oss}$
- $C_{iss}$

Capacitance $C$ (pF)

Gate to Source Voltage $V_{GS}$ (V)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Gate Charge $Q_g$ (nC)

Reverse Drain Current vs. Source to Drain Voltage

- $V_{GS} = 0$ V

Reverse Drain Current $I_{BR}$ (A)

Source to Drain Voltage $V_{SD}$ (V)

Static Drain to Source on State Resistance $R_{DS(on)}$ (mΩ)

Pulse Test

- $I_D = 12.5$ A
- $V_{GS}$

Source to Drain Voltage $V_{SD}$ (V)

Capacitance $C$ (pF)

Gate Charge $Q_g$ (nC)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Gate Charge $Q_g$ (nC)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)

Dynamic Input Characteristics

- $I_D = 25$ A
- $V_{DD} = 50$ V
- $V_{DS}$

Drain to Source Voltage $V_{DS}$ (V)
**Normalized Transient Thermal Impedance vs. Pulse Width**

- **Avalanche Test Circuit**
  - D.U.T. (Device Under Test)
  - Vin: Monitor
  - VDS: Monitor

- **Switching Time Test Circuit**
  - Vin Monitor
  - Vout Monitor

- **Avalanche Waveform**
  - \( E_{AS} = \frac{1}{2} L \cdot I_{AP}^2 \cdot \frac{V_{DSS}}{V_{DSS} - V_{DD}} \)

- **Switching Time Waveform**
  - Vd(on)
  - T
  - Vd(off)
  - Tr

**Symbols and Equations**

- \( V_{DD} \)
- \( V_{DS} \)
- \( I_{AP} \)
- \( V_{DSS} \)
- \( T_{c} = 25^\circ C \)
- \( \gamma_s(t) \)
- \( \theta_{ch-c} = 2.78^\circ C/W \)

**Parameters**

- Vin: 15 V
- Vout: Monitor
- RL: 50 Ω
- VDS: 30 V

**Circuit Diagrams**

- Avalanche Test Circuit
- Switching Time Test Circuit

**Equation**

- \( \theta_{ch-c} = \gamma_s(t) \cdot \theta_{ch-c} \)

**Notes**

- Pulse Width (PW) vs. Normalized Transient Thermal Impedance
- Avalanche Test Circuit with Pulse Width PW (s)
- Switching Time Test Circuit with Vin and Vout

**Parameters**

- D = 1
- 0.5
- 0.2
- 0.1
- 0.05
- 0.02
- 0.01
- 0.005

- Tc = 25°C

**Waveform**

- Vin: 10 V
- Vout: 90% 10% 90% 10%
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>LFPAK</td>
<td>SC-100</td>
<td>P12Z0000DRA</td>
<td>LFPAKV</td>
<td>0.080g</td>
</tr>
</tbody>
</table>

Unit: mm

Ordering Information

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Quantity</th>
<th>Shipping Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJK0651DPB-00-J5</td>
<td>2500 pcs</td>
<td>Taping</td>
</tr>
</tbody>
</table>

(Ni/Pd/Au plating)
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