Description

The NP89N04PUK is N-channel MOS Field Effect Transistor designed for high current switching applications.

Features

- Super low on-state resistance
  \[ R_{DS(on)} = 2.95 \, \text{m}\Omega \, \text{MAX.} \quad (V_{GS} = 10 \, \text{V}, \quad I_D = 45 \, \text{A}) \]
- Low \( C_{iss} \): \( C_{iss} = 3900 \, \text{pF TYP.} \quad (V_{DS} = 25 \, \text{V}) \)
- Designed for automotive application and AEC-Q101 qualified

Ordering Information

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Lead Plating</th>
<th>Packing</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP89N04PUK-E1-AY</td>
<td>Pure Sn (Tin)</td>
<td>Tape 800 p/reel</td>
<td>Taping (E1 type)</td>
</tr>
<tr>
<td>NP89N04PUK-E2-AY</td>
<td></td>
<td></td>
<td>TO-263 (MP-25ZP)</td>
</tr>
<tr>
<td></td>
<td>*1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *1 Pb-free (This product does not contain Pb in the external electrode)

Absolute Maximum Ratings \( (T_A = 25^\circ \text{C}) \)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain to Source Voltage ( (V_{GS} = 0 , \text{V}) )</td>
<td>( V_{DS} )</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td>Gate to Source Voltage ( (V_{DS} = 0 , \text{V}) )</td>
<td>( V_{GS} )</td>
<td>( \pm 20 )</td>
<td>V</td>
</tr>
<tr>
<td>Drain Current (DC) ( (T_C = 25^\circ \text{C}) )</td>
<td>( I_D(DC) )</td>
<td>( \pm 90 )</td>
<td>A</td>
</tr>
<tr>
<td>Drain Current (pulse) *1, 3</td>
<td>( I_D(pulse) )</td>
<td>( \pm 360 )</td>
<td>A</td>
</tr>
<tr>
<td>Total Power Dissipation ( (T_C = 25^\circ \text{C}) )</td>
<td>( P_{T1} )</td>
<td>147</td>
<td>W</td>
</tr>
<tr>
<td>Total Power Dissipation ( (T_A = 25^\circ \text{C}) )</td>
<td>( P_{T2} )</td>
<td>1.8</td>
<td>W</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>( T_{ch} )</td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>( T_{stg} )</td>
<td>(-55) to 175</td>
<td>°C</td>
</tr>
<tr>
<td>Repetitive Avalanche Current *2, 3</td>
<td>( I_{AR} )</td>
<td>37</td>
<td>A</td>
</tr>
<tr>
<td>Repetitive Avalanche Energy *2, 3</td>
<td>( E_{AR} )</td>
<td>136</td>
<td>mJ</td>
</tr>
</tbody>
</table>

Thermal Resistance

- Channel to Case Thermal Resistance \( R_{th(ch-C)} *3 \) 1.02 °C/W
- Channel to Ambient Thermal Resistance \( R_{th(ch-A)} *3 \) 83.3 °C/W

Notes: *1 \( T_C = 25^\circ \text{C}, \quad P_W \leq 10 \, \mu\text{s}, \quad \text{Duty Cycle} \leq 1\% \)
*2 \( R_G = 25 \, \Omega, \quad V_{GS} = 20 \rightarrow 0 \, \text{V} \)
*3 Not subject of production test. Verified by design/characterization.
## 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>Zero Gate Voltage Drain Current</td>
<td>I_DSS</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>μA</td>
<td>V_DS = 40 V, V_GS = 0 V</td>
</tr>
<tr>
<td>Gate Leakage Current</td>
<td>I_GSS</td>
<td>—</td>
<td>—</td>
<td>±100</td>
<td>nA</td>
<td>V_DS = ±20 V, V_DS = 0 V</td>
</tr>
<tr>
<td>Gate to Source Threshold Voltage</td>
<td>V_GS(th)</td>
<td>2.0</td>
<td>3.0</td>
<td>4.0</td>
<td>V</td>
<td>V_DS = V_GS, I_D = 250 μA</td>
</tr>
<tr>
<td>Forward Transfer Admittance *1</td>
<td></td>
<td></td>
<td>30</td>
<td>60</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Drain to Source On-state Resistance *1</td>
<td>R_DSS(on)</td>
<td>—</td>
<td>2.45</td>
<td>2.95</td>
<td>mΩ</td>
<td></td>
</tr>
<tr>
<td>Input Capacitance *2</td>
<td>C_iss</td>
<td>—</td>
<td>3900</td>
<td>5850</td>
<td>pF</td>
<td>V_DS = 25 V</td>
</tr>
<tr>
<td>Output Capacitance *2</td>
<td>Coss</td>
<td>—</td>
<td>530</td>
<td>800</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>Reverse Transfer Capacitance *2</td>
<td>Coss</td>
<td>—</td>
<td>200</td>
<td>360</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>Turn-on Delay Time *2</td>
<td>t_d(on)</td>
<td>—</td>
<td>25</td>
<td>60</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Rise Time *2</td>
<td>t_r</td>
<td>—</td>
<td>12</td>
<td>30</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Turn-off Delay Time *2</td>
<td>t_d(off)</td>
<td>—</td>
<td>65</td>
<td>130</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Fall Time *2</td>
<td>t_f</td>
<td>—</td>
<td>8</td>
<td>20</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Total Gate Charge *2</td>
<td>Q_G</td>
<td>—</td>
<td>68</td>
<td>102</td>
<td>nC</td>
<td>V_DD = 32 V</td>
</tr>
<tr>
<td>Gate to Source Charge</td>
<td>Q_GS</td>
<td>—</td>
<td>18</td>
<td>—</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>Gate to Drain Charge</td>
<td>Q_GD</td>
<td>—</td>
<td>18</td>
<td>—</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>Body Diode Forward Voltage *1</td>
<td>V_F(S-D)</td>
<td>—</td>
<td>0.9</td>
<td>1.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Reverse Recovery Time</td>
<td>t_r</td>
<td>—</td>
<td>47</td>
<td>—</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Reverse Recovery Charge</td>
<td>Q_rr</td>
<td>—</td>
<td>68</td>
<td>—</td>
<td>nC</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
*1 Pulsed test
*2 Not subject of production test. Verified by design/characterization.

### TEST CIRCUIT 1 AVALANCHE CAPABILITY

![TEST CIRCUIT 1 AVALANCHE CAPABILITY](image1)

### TEST CIRCUIT 2 SWITCHING TIME

![TEST CIRCUIT 2 SWITCHING TIME](image2)

### TEST CIRCUIT 3 GATE CHARGE

![TEST CIRCUIT 3 GATE CHARGE](image3)
Typical Characteristics \((T_A = 25^\circ C)\)

### DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA

- **dT** - Percentage of Rated Power - %
- **TC** - Case Temperature - °C

### TOTAL POWER DISSIPATION vs. CASE TEMPERATURE

- **Pr** - Total Power Dissipation - W
- **TC** - Case Temperature - °C

### FORWARD BIAS SAFE OPERATING AREA

- **ID** - Drain Current - A
- **VDS** - Drain to Source Voltage - V

### TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

- **Rth** - Transient Thermal Resistance - °C/W
- **PW** - Pulse Width - s
Package Drawing (Unit: mm)

TO-263 (MP-25ZP) (Mass: 1.5 g TYP.)

Equivalent Circuit

Remark: Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.
## Revision History

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Page</th>
<th>Summary</th>
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<tr>
<td>1.00</td>
<td>Nov 07, 2011</td>
<td>—</td>
<td>First Edition Issued</td>
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<td>2.00</td>
<td>May 24, 2018</td>
<td>1</td>
<td>Note 3 was added</td>
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