1. Product profile

1.1 General description
Standard level N-channel MOSFET in a D2PAK package qualified to 175°C. This product is designed and qualified for use in a wide range of industrial, communications and domestic equipment.

1.2 Features and benefits
- High efficiency due to low switching and conduction losses
- Suitable for standard level gate drive

1.3 Applications
- DC-to-DC converters
- Load switching
- Motor control
- Server power supplies

1.4 Quick reference data

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DS}$</td>
<td>drain-source voltage</td>
<td>$T_j \geq 25 ^\circ C;\ T_j \leq 175 ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>V</td>
</tr>
<tr>
<td>$I_D$</td>
<td>drain current</td>
<td>$T_{mb} = 25 ^\circ C;\ V_{GS} = 10 \text{ V}$</td>
<td>-</td>
<td>-</td>
<td>89</td>
<td>A</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_{mb} = 25 ^\circ C$; see Figure 2</td>
<td>-</td>
<td>-</td>
<td>211</td>
<td>W</td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td></td>
<td>-55</td>
<td>-</td>
<td>175</td>
<td>°C</td>
</tr>
</tbody>
</table>

Static characteristics
- $R_{DSon}$: drain-source on-state resistance
  - $V_{GS} = 10 \text{ V};\ I_D = 15 \text{ A};\ T_j = 25 ^\circ C$; see Figure 13
  - Min: 8.16 mΩ, Typ: 9.6 mΩ

Dynamic characteristics
- $Q_{GD}$: gate-drain charge
  - $V_{GS} = 10 \text{ V};\ I_D = 60 \text{ A};\ V_{DS} = 50 \text{ V}$; see Figure 14; see Figure 15
  - Min: 23 nC, Typ: - nC
- $Q_{G(tot)}$: total gate charge
  - Min: 82 nC, Typ: - nC

Avalanche ruggedness
- $E_{DS(ALS)}$: non-repetitive drain-source avalanche energy
  - $V_{GS} = 10 \text{ V};\ T_{(init)} = 25 ^\circ C;\ I_D = 89 \text{ A}; \ V_{sup} \leq 100 \text{ V};\ \text{unclamped};\ R_{GS} = 50 \Omega$
  - Min: - mJ, Typ: 177 mJ
2. Pinning information

Table 2. Pinning information

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
<th>Simplified outline</th>
<th>Graphic symbol</th>
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<tbody>
<tr>
<td>1</td>
<td>G</td>
<td>gate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td>drain[1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>S</td>
<td>source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mb</td>
<td>D</td>
<td>mounting base; connected to drain</td>
<td></td>
<td></td>
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</table>

[1] It is not possible to make connection to pin 2.

3. Ordering information

Table 3. Ordering information

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Description</th>
<th>Version</th>
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<tr>
<td>PSMN9R5-100BS</td>
<td>D2PAK</td>
<td>plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)</td>
<td>SOT404</td>
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4. Limiting values

Table 4. Limiting values

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_DS</td>
<td>drain-source voltage</td>
<td>T_J ≥ 25 °C; T_J ≤ 175 °C</td>
<td>-</td>
<td>100</td>
<td>V</td>
</tr>
<tr>
<td>V_DGR</td>
<td>drain-gate voltage</td>
<td>T_J ≤ 175 °C; T_J ≥ 25 °C; R_GS = 20 kΩ</td>
<td>-</td>
<td>100</td>
<td>V</td>
</tr>
<tr>
<td>V_GS</td>
<td>gate-source voltage</td>
<td>V_GS = 10 V; T_mb = 100 °C; see Figure 1</td>
<td>-</td>
<td>63</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_GS = 10 V; T_mb = 25 °C; see Figure 1</td>
<td>-</td>
<td>89</td>
<td>A</td>
</tr>
<tr>
<td>I_D</td>
<td>drain current</td>
<td>pulsed; T_p ≤ 10 µs; T_mb = 25 °C; see Figure 3</td>
<td>-</td>
<td>355</td>
<td>A</td>
</tr>
<tr>
<td>I_DM</td>
<td>peak drain current</td>
<td>pulsed; T_p ≤ 10 µs; T_mb = 25 °C; see Figure 3</td>
<td>-</td>
<td>355</td>
<td>A</td>
</tr>
<tr>
<td>P_tot</td>
<td>total power dissipation</td>
<td>T_mb = 25 °C; see Figure 2</td>
<td>-</td>
<td>211</td>
<td>W</td>
</tr>
<tr>
<td>T_stg</td>
<td>storage temperature</td>
<td></td>
<td>-55</td>
<td>175</td>
<td>°C</td>
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<tr>
<td>T_J</td>
<td>junction temperature</td>
<td></td>
<td>-55</td>
<td>175</td>
<td>°C</td>
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<tr>
<td>T_sld(M)</td>
<td>peak soldering temperature</td>
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<td>-</td>
<td>260</td>
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Source-drain diode

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<th>Max</th>
<th>Unit</th>
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<tbody>
<tr>
<td>I_S</td>
<td>source current</td>
<td>T_mb = 25 °C</td>
<td>-</td>
<td>89</td>
<td>A</td>
</tr>
<tr>
<td>I_SM</td>
<td>peak source current</td>
<td>pulsed; T_p ≤ 10 µs; T_mb = 25 °C</td>
<td>-</td>
<td>355</td>
<td>A</td>
</tr>
</tbody>
</table>

Avalanche ruggedness

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>E_DS(AL)S</td>
<td>non-repetitive drain-source avalanche energy</td>
<td>V_GS = 10 V; T_J(init) = 25 °C; I_D = 89 A; V_sup ≤ 100 V, unclamped; R_GS = 50 Ω</td>
<td>-</td>
<td>177</td>
<td>mJ</td>
</tr>
</tbody>
</table>
Fig 1. Continuous drain current as a function of mounting base temperature

Fig 2. Normalized total power dissipation as a function of mounting base temperature

Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage
5. Thermal characteristics

Table 5. Thermal characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_{th(j-mb)}</td>
<td>thermal resistance from junction</td>
<td>see Figure 4</td>
<td>-</td>
<td>0.38</td>
<td>0.71</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td>to mounting base</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R_{th(j-a)}</td>
<td>thermal resistance from junction</td>
<td>Minimum footprint; mounted on a</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td>to ambient</td>
<td>printed circuit board</td>
<td></td>
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</table>

Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration
### 6. Characteristics

#### Table 6. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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<tr>
<td><strong>Static characteristics</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>$V_{(BR)DSS}$</td>
<td>drain-source breakdown voltage</td>
<td>$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = -55 \degree C$</td>
<td>90</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \degree C$</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GS(th)}$</td>
<td>gate-source threshold voltage</td>
<td>$I_D = 1 \text{ mA}; V_D = V_{GS}; T_j = 175 \degree C$</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>see Figure 10; see Figure 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_D = 1 \text{ mA}; V_D = V_{GS}; T_j = 25 \degree C$</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>see Figure 10; see Figure 11</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>$I_D = 1 \text{ mA}; V_D = V_{GS}; T_j = -55 \degree C$</td>
<td>-</td>
<td>-</td>
<td>4.8</td>
<td>V</td>
</tr>
<tr>
<td>$I_{DSS}$</td>
<td>drain leakage current</td>
<td>$V_D = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \degree C$</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>µA</td>
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<td>$V_D = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \degree C$</td>
<td>-</td>
<td>0.02</td>
<td>4</td>
<td>µA</td>
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<tr>
<td>$I_{GSS}$</td>
<td>gate leakage current</td>
<td>$V_{GS} = 20 \text{ V}; V_D = 0 \text{ V}; T_j = 25 \degree C$</td>
<td>-</td>
<td>10</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = -20 \text{ V}; V_D = 0 \text{ V}; T_j = 25 \degree C$</td>
<td>-</td>
<td>10</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>$R_{DSon}$</td>
<td>drain-source on-state resistance</td>
<td>$V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_j = 100 \degree C$</td>
<td>-</td>
<td>-</td>
<td>17.3</td>
<td>mΩ</td>
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<td></td>
<td></td>
<td>see Figure 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_j = 25 \degree C$</td>
<td>-</td>
<td>23.5</td>
<td>27.4</td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>see Figure 12</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>$V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_j = 75 \degree C$</td>
<td>-</td>
<td>8.16</td>
<td>9.6</td>
<td>mΩ</td>
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<td>see Figure 13</td>
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<tr>
<td>$R_G$</td>
<td>internal gate resistance (AC)</td>
<td>$f = 1 \text{ MHz}$</td>
<td>-</td>
<td>0.7</td>
<td>-</td>
<td>Ω</td>
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<tr>
<td><strong>Dynamic characteristics</strong></td>
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<tr>
<td>$Q_{G(tot)}$</td>
<td>total gate charge</td>
<td>$I_D = 0 \text{ A}; V_D = 0 \text{ V}; V_{GS} = 10 \text{ V}$</td>
<td>-</td>
<td>67</td>
<td>-</td>
<td>nC</td>
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<tr>
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<td>$I_D = 60 \text{ A}; V_D = 50 \text{ V}; V_{GS} = 10 \text{ V}$</td>
<td>-</td>
<td>82</td>
<td>-</td>
<td>nC</td>
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<td>$I_D = 60 \text{ A}; V_D = 50 \text{ V}; V_{GS} = 3 \text{ V}$</td>
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<td>21</td>
<td>-</td>
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<td>$Q_{GS}$</td>
<td>gate-source charge</td>
<td>$I_D = 60 \text{ A}; V_D = 50 \text{ V}; V_{GS} = 10 \text{ V}$</td>
<td>-</td>
<td>13.1</td>
<td>-</td>
<td>nC</td>
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<tr>
<td>$Q_{GS(th)}$</td>
<td>pre-threshold gate-source charge</td>
<td>$I_D = 60 \text{ A}; V_D = 50 \text{ V}; V_{GS} = 10 \text{ V}$</td>
<td>-</td>
<td>7.8</td>
<td>-</td>
<td>nC</td>
</tr>
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<td></td>
<td></td>
<td>see Figure 14</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>$Q_{GS(th-pl)}$</td>
<td>post-threshold gate-source charge</td>
<td>$I_D = 60 \text{ A}; V_D = 50 \text{ V}; V_{GS} = 10 \text{ V}$</td>
<td>-</td>
<td>23</td>
<td>-</td>
<td>nC</td>
</tr>
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<td>see Figure 14</td>
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<tr>
<td>$Q_{GD}$</td>
<td>gate-drain charge</td>
<td>$I_D = 60 \text{ A}; V_D = 50 \text{ V}; V_{GS} = 10 \text{ V}$</td>
<td>-</td>
<td>23</td>
<td>-</td>
<td>nC</td>
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<td></td>
<td></td>
<td>see Figure 14</td>
<td></td>
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<tr>
<td>$V_{GS(pl)}$</td>
<td>gate-source plateau voltage</td>
<td>$V_D = 50 \text{ V}; see Figure 14;$</td>
<td>-</td>
<td>4.5</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>see Figure 15</td>
<td></td>
<td></td>
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<tr>
<td>$C_{iss}$</td>
<td>input capacitance</td>
<td>$V_D = 50 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$</td>
<td>-</td>
<td>4454</td>
<td>-</td>
<td>pF</td>
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<tr>
<td></td>
<td></td>
<td>$T_j = 25 \degree C$; see Figure 16</td>
<td></td>
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<tr>
<td>$C_{oss}$</td>
<td>output capacitance</td>
<td>$V_D = 50 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$</td>
<td>-</td>
<td>302</td>
<td>-</td>
<td>pF</td>
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<td>$T_j = 25 \degree C$; see Figure 16</td>
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<tr>
<td>$C_{rss}$</td>
<td>reverse transfer capacitance</td>
<td>$V_D = 50 \text{ V}; see Figure 14;$</td>
<td>-</td>
<td>185</td>
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<td>pF</td>
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<td></td>
<td>see Figure 15</td>
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<tr>
<td>$t_{on}$</td>
<td>turn-on delay time</td>
<td>$V_D = 50 \text{ V}; R_L = 0.8 \Omega; V_{GS} = 10 \text{ V}$</td>
<td>-</td>
<td>22</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$R_{G(ext)} = 4.7 \Omega; T_j = 25 \degree C$</td>
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<td></td>
</tr>
<tr>
<td>$t_r$</td>
<td>rise time</td>
<td>$R_{G(ext)} = 4.7 \Omega; T_j = 25 \degree C$</td>
<td>-</td>
<td>52.2</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>$t_{off}$</td>
<td>turn-off delay time</td>
<td>$R_{G(ext)} = 4.7 \Omega; T_j = 25 \degree C$</td>
<td>-</td>
<td>22.8</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>$t_f$</td>
<td>fall time</td>
<td>$R_{G(ext)} = 4.7 \Omega; T_j = 25 \degree C$</td>
<td>-</td>
<td>52.2</td>
<td>-</td>
<td>ns</td>
</tr>
</tbody>
</table>
Table 6. Characteristics …continued

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{SD}$</td>
<td>source-drain voltage</td>
<td>$I_S = 15$ A; $V_{GS} = 0$ V; $T_J = 25$ °C; see Figure 17</td>
<td>-</td>
<td>0.85</td>
<td>1.2</td>
<td>V</td>
</tr>
<tr>
<td>$t_{tr}$</td>
<td>reverse recovery time</td>
<td>$I_S = 20$ A; $dI_S/dt = 100$ A/µs; $V_{GS} = 0$ V;</td>
<td>-</td>
<td>61.5</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>$Q_r$</td>
<td>recovered charge</td>
<td>$V_{DS} = 50$ V</td>
<td>-</td>
<td>157</td>
<td>-</td>
<td>nC</td>
</tr>
</tbody>
</table>

Fig 5. Drain-source on-state resistance as a function of gate-source voltage; typical values

Fig 6. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

Fig 7. Forward transconductance as a function of drain current; typical values

Fig 8. Output characteristics: drain current as a function of drain-source voltage; typical values
Fig 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$$V_{DS} \geq I_D \times R_{DS\,on}$$

Fig 10. Sub-threshold drain current as a function of gate-source voltage

$$T_J = 25\,^\circ C; V_{DS} = 5V$$

Fig 11. Gate-source threshold voltage as a function of junction temperature

$$I_D = 1\,mA; V_{DS} = V_{GS}$$

Fig 12. Normalized drain-source on-state resistance factor as a function of junction temperature

$$a = \frac{R_{DS\,on}}{R_{DS\,on(25\,^\circ C)}}$$
**PSMN9R5-100BS**

N-channel 100 V 9.6 mΩ standard level MOSFET in D2PAK

---

**Fig 13.** Drain-source on-state resistance as a function of drain current; typical values

**Fig 14.** Gate charge waveform definitions

**Fig 15.** Gate-source voltage as a function of gate charge; typical values

**Fig 16.** Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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*Figures and data provided in this document are subject to legal disclaimers.*
Fig 17. Source current as a function of source-drain voltage; typical values
7. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)

**DIMENSIONS (mm are the original dimensions)**

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**REFERENCES**

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**EUROPEAN PROJECTION**

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Fig 18. Package outline SOT404 (D2PAK)
8. Revision history

Table 7. Revision history

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9. Legal information

9.1 Data sheet status

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<td>Product [short] data sheet</td>
<td>Production</td>
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[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL: http://www.nexperia.com.

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