1. Product profile

1.1 General description
N-channel enhancement mode Field-Effect Transistor (FET) in a leadless medium power DFN2020MD-6 (SOT1220) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

1.2 Features and benefits
- 2.2 kV ESD protection
- Small and leadless ultra thin SMD plastic package: 2 x 2 x 0.65 mm
- Exposed drain pad for excellent thermal conduction
- Tin-plated, 100% solderable side pads for optical solder inspection

1.3 Applications
- Charging switch for portable devices
- DC-to-DC converters
- Power management in battery-driven portables
- Hard disk and computing power management

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>$T_j = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>V_GS</td>
<td>gate-source voltage</td>
<td></td>
<td>-12</td>
<td>-</td>
<td>12</td>
<td>V</td>
</tr>
<tr>
<td>I_D</td>
<td>drain current</td>
<td>$V_{GS} = 4.5 , \text{V}; T_{amb} = 25 , ^\circ\text{C}; t \leq 5 , \text{s}$</td>
<td>[1]</td>
<td>-</td>
<td>12.9</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Static characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{DSon}$</td>
</tr>
</tbody>
</table>

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm².
2. Pinning information

Table 2. Pinning information

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>D</td>
<td>drain</td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td>drain</td>
</tr>
<tr>
<td>3</td>
<td>G</td>
<td>gate</td>
</tr>
<tr>
<td>4</td>
<td>S</td>
<td>source</td>
</tr>
<tr>
<td>5</td>
<td>D</td>
<td>drain</td>
</tr>
<tr>
<td>6</td>
<td>D</td>
<td>drain</td>
</tr>
<tr>
<td>7</td>
<td>D</td>
<td>drain</td>
</tr>
<tr>
<td>8</td>
<td>S</td>
<td>source</td>
</tr>
</tbody>
</table>

3. Ordering information

Table 3. Ordering information

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMPB10XNE</td>
<td>DFN2020MD-6</td>
<td>plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals</td>
</tr>
</tbody>
</table>

4. Marking

Table 4. Marking codes

<table>
<thead>
<tr>
<th>Type number</th>
<th>Marking code</th>
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<tbody>
<tr>
<td>PMPB10XNE</td>
<td>1H</td>
</tr>
</tbody>
</table>

5. Limiting values

Table 5. 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</td>
<td>-</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>V_{GS}</td>
<td>gate-source voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_D</td>
<td>drain current</td>
<td>V_{GS} = 4.5 V; T_amb = 25 °C; t ≤ 5 s</td>
<td>-12</td>
<td>12</td>
<td>V</td>
</tr>
<tr>
<td>I_{DM}</td>
<td>peak drain current</td>
<td>V_{GS} = 4.5 V; T_amb = 25 °C</td>
<td>-</td>
<td>9</td>
<td>A</td>
</tr>
<tr>
<td>I_{DM}</td>
<td>peak drain current</td>
<td>V_{GS} = 4.5 V; T_amb = 100 °C</td>
<td>[1]</td>
<td>5.7</td>
<td>A</td>
</tr>
<tr>
<td>P_{tot}</td>
<td>total power dissipation</td>
<td>T_amb = 25 °C; single pulse; t_p ≤ 10 µs</td>
<td>-</td>
<td>36</td>
<td>A</td>
</tr>
</tbody>
</table>
### Symbol, Parameter, Conditions, Min, Max, Unit

<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>$T_{\text{amb}}$</td>
<td>ambient temperature</td>
<td>$T_{\text{amb}} = 25 \degree C; t \leq 5 \text{ s}$</td>
<td>-3.5</td>
<td>3.5</td>
<td>W</td>
</tr>
<tr>
<td>$T_{\text{sp}}$</td>
<td></td>
<td>$T_{\text{sp}} = 25 \degree C$</td>
<td>-12.5</td>
<td>12.5</td>
<td>W</td>
</tr>
<tr>
<td>$T_{\text{j}}$</td>
<td>junction temperature</td>
<td></td>
<td>-55</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{\text{amb}}$</td>
<td>ambient temperature</td>
<td></td>
<td>-55</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{\text{stg}}$</td>
<td>storage temperature</td>
<td></td>
<td>-65</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

### Source-drain diode

- $I_S$: source current, $T_{\text{amb}} = 25 \degree C$  
<table>
<thead>
<tr>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>2</td>
<td>A</td>
</tr>
</tbody>
</table>

### ESD maximum rating

- $V_{\text{ESD}}$: electrostatic discharge voltage  
<table>
<thead>
<tr>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>2200</td>
<td>V</td>
</tr>
</tbody>
</table>

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm².

---

**Fig. 1. Normalized total power dissipation as a function of junction temperature**

$$P_{\text{der}} = \frac{P_{\text{JG}}}{P_{\text{TJG5V}}} \times 100 \%$$

**Fig. 2. Normalized continuous drain current as a function of junction temperature**

$$I_{\text{der}} = \frac{I_D}{I_{D(65^\circ C)}} \times 100 \%$$
6. Thermal characteristics

Table 6. 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>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient</td>
<td>in free air</td>
<td>[1] 235</td>
<td>270</td>
<td>K/W</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>in free air; $t \leq 5,s$</td>
<td>[2] 67</td>
<td>74</td>
<td>K/W</td>
<td></td>
</tr>
<tr>
<td>$R_{th(j-sp)}$</td>
<td>thermal resistance from junction to solder point</td>
<td>-</td>
<td>5</td>
<td>10</td>
<td>K/W</td>
<td></td>
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</tbody>
</table>

7. Characteristics

Table 7. 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>$V_{BRDSS}$</td>
<td>drain-source breakdown voltage</td>
<td>$I_D = 250 , \mu A; V_{GS} = 0 , V; T_J = 25 , ^\circ C$</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GSth}$</td>
<td>gate-source threshold voltage</td>
<td>$I_D = 250 , \mu A; V_{DS} = V_{GS}; T_J = 25 , ^\circ C$</td>
<td>0.4</td>
<td>0.65</td>
<td>0.9</td>
<td>V</td>
</tr>
<tr>
<td>$I_{DSS}$</td>
<td>drain leakage current</td>
<td>$V_{DS} = 20 , V; V_{GS} = 0 , V; T_J = 25 , ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>$\mu A$</td>
</tr>
<tr>
<td>$I_{GSS}$</td>
<td>gate leakage current</td>
<td>$V_{GS} = 8 , V; V_{DS} = 0 , V; T_J = 25 , ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>$\mu A$</td>
</tr>
</tbody>
</table>

FR4 PCB, standard footprint

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

FR4 PCB, mounting pad for drain 6 cm$^2$

Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values
### Symbol | Parameter | Conditions | Min | Typ | Max | Unit
--- | --- | --- | --- | --- | --- | ---
$V_{GS} = -8\, \text{V}$; $V_{DS} = 0\, \text{V}$; $T_J = 25\, ^\circ\text{C}$ | | - | - | -10 | $\mu\text{A}$
$R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 4.5\, \text{V}$; $I_D = 9\, \text{A}$; $T_J = 25\, ^\circ\text{C}$ | - | 10 | 14 | $\text{m}\Omega$
$V_{GS} = 4.5\, \text{V}$; $I_D = 9\, \text{A}$; $T_J = 150\, ^\circ\text{C}$ | - | 15 | 21 | $\text{m}\Omega$
$V_{GS} = 2.5\, \text{V}$; $I_D = 8\, \text{A}$; $T_J = 25\, ^\circ\text{C}$ | - | 12 | 18 | $\text{m}\Omega$
$V_{GS} = 1.8\, \text{V}$; $I_D = 3.7\, \text{A}$; $T_J = 25\, ^\circ\text{C}$ | - | 16 | 25 | $\text{m}\Omega$
$g_{fs}$ | forward transconductance | $V_{DS} = 10\, \text{V}$; $I_D = 9\, \text{A}$; $T_J = 25\, ^\circ\text{C}$ | - | 60 | - | $\text{S}$
$R_G$ | gate resistance | $f = 1\, \text{MHz}$ | - | 2 | - | $\Omega$

### Dynamic characteristics

- $Q_{G(tot)}$ | total gate charge | $V_{DS} = 10\, \text{V}$; $I_D = 6\, \text{A}$; $V_{GS} = 4.5\, \text{V}$; $T_J = 25\, ^\circ\text{C}$ | - | 23 | 34 | nC
- $Q_{GS}$ | gate-source charge | - | 2.6 | - | nC
- $Q_{GD}$ | gate-drain charge | - | 4.5 | - | nC
- $C_{iss}$ | input capacitance | $V_{DS} = 10\, \text{V}$; $f = 1\, \text{MHz}$; $V_{GS} = 0\, \text{V}$; $T_J = 25\, ^\circ\text{C}$ | - | 2175 | - | pF
- $C_{oss}$ | output capacitance | - | 235 | - | pF
- $C_{rss}$ | reverse transfer capacitance | - | 205 | - | pF
- $t_{(on)}$ | turn-on delay time | $V_{DS} = 10\, \text{V}$; $I_D = 6\, \text{A}$; $V_{GS} = 4.5\, \text{V}$; $R_{G(ext)} = 6\, \Omega$; $T_J = 25\, ^\circ\text{C}$ | - | 13 | - | ns
- $t_{r}$ | rise time | - | 35 | - | ns
- $t_{(off)}$ | turn-off delay time | - | 54 | - | ns
- $t_{f}$ | fall time | - | 50 | - | ns

### Source-drain diode

- $V_{SD}$ | source-drain voltage | $I_S = 2\, \text{A}$; $V_{GS} = 0\, \text{V}$; $T_J = 25\, ^\circ\text{C}$ | - | 0.6 | 1.2 | V

---

**Fig. 6.** Output characteristics: drain current as a function of drain-source voltage; typical values

**Fig. 7.** Subthreshold drain current as a function of gate-source voltage
Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values
Fig. 12. Gate-source threshold voltage as a function of junction temperature

\[
I_D = 0.25 \text{ mA; } V_{DS} = V_{GS}
\]

Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

\[
f = 1 \text{ MHz; } V_{GS} = 0 \text{ V}
\]

Fig. 14. Gate-source voltage as a function of gate charge; typical values

\[
I_D = 9 \text{ A; } V_{DS} = 10 \text{ V; } T_{\text{amb}} = 25 \text{ °C}
\]

Fig. 15. Source current as a function of source-drain voltage; typical values

\[
V_{GS} = 0 \text{ V}
\]
8. Test information

![Duty cycle definition](image)

Fig. 16. Duty cycle definition

9. Package outline

![Package outline DFN2020MD-6 (SOT1220)](image)

Fig. 17. Package outline DFN2020MD-6 (SOT1220)
10. Soldering

Footprint information for reflow soldering of DFN2020MD-6 package

Fig. 18. Reflow soldering footprint for DFN2020MD-6 (SOT1220)
11. Revision history

Table 8. Revision history

<table>
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<tr>
<th>Data sheet ID</th>
<th>Release date</th>
<th>Data sheet status</th>
<th>Change notice</th>
<th>Supersedes</th>
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<tr>
<td>PMPB10XNE v.1</td>
<td>20121130</td>
<td>Product data sheet</td>
<td>-</td>
<td>-</td>
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12. Legal information

12.1 Data sheet status

<table>
<thead>
<tr>
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<tr>
<td>Objective [short] data sheet</td>
<td>Development</td>
<td>This document contains data from the objective specification for product development.</td>
</tr>
<tr>
<td>Preliminary [short] data sheet</td>
<td>Qualification</td>
<td>This document contains data from the preliminary specification.</td>
</tr>
<tr>
<td>Product [short] data sheet</td>
<td>Production</td>
<td>This document contains the product specification.</td>
</tr>
</tbody>
</table>

[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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For more information, please visit: http://www.nexperia.com
For sales office addresses, please send an email to: salesaddresses@nexperia.com

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