# PMPB23XNE

## 20 V, single N-channel Trench MOSFET

30 November 2012 Product data sheet

## 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

- 2.1 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

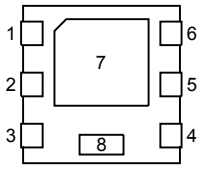
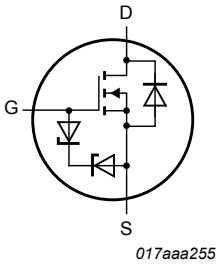
**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j$ = 25 °C | | - | - | 20 | V |
| $V_{GS}$ | gate-source voltage | | | -12 | - | 12 | V |
| $I_D$ | drain current | $V_{GS}$ = 4.5 V; $T_{amb}$ = 25 °C; t ≤ 5 s | [1] | - | - | 10.1 | A |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 4.5 V; $I_D$ = 7 A; $T_j$ = 25 °C | | - | 19 | 22 | mΩ |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 $cm^2$.

## 2. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | D | drain |  Transparent top view **DFN2020MD-6 (SOT1220)** |  |
| 2 | D | drain | | |
| 3 | G | gate | | |
| 4 | S | source | | |
| 5 | D | drain | | |
| 6 | D | drain | | |
| 7 | D | drain | | |
| 8 | S | source | | |

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PMPB23XNE | DFN2020MD-6 | plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals | SOT1220 |

## 4. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| PMPB23XNE | 1K |

## 5. Limiting values

**Table 5. Limiting values**

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j$ = 25 °C | | - | 20 | V |
| $V_{GS}$ | gate-source voltage | | | -12 | 12 | V |
| $I_D$ | drain current | $V_{GS}$ = 4.5 V; $T_{amb}$ = 25 °C; t ≤ 5 s | [1] | - | 10.1 | A |
| | | $V_{GS}$ = 4.5 V; $T_{amb}$ = 25 °C | [1] | - | 7 | A |
| | | $V_{GS}$ = 4.5 V; $T_{amb}$ = 100 °C | [1] | - | 4.4 | A |
| $I_{DM}$ | peak drain current | $T_{amb}$ = 25 °C; single pulse; $t_p$ ≤ 10 µs | | - | 24 | A |
| $P_{tot}$ | total power dissipation | $T_{amb}$ = 25 °C | [1] | - | 1.7 | W |

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| | | $T_{amb}$ = 25 °C; t ≤ 5 s | [1] | - | 3.5 | W |
| | | $T_{sp}$ = 25 °C | | - | 12.5 | W |
| $T_j$ | junction temperature | | | -55 | 150 | °C |
| $T_{amb}$ | ambient temperature | | | -55 | 150 | °C |
| $T_{stg}$ | storage temperature | | | -65 | 150 | °C |
| **Source-drain diode** | | | | | | |
| $I_S$ | source current | $T_{amb}$ = 25 °C | [1] | - | 1.9 | A |
| **ESD maximum rating** | | | | | | |
| $V_{ESD}$ | electrostatic discharge voltage | HBM | [2] | - | 2100 | V |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 $cm^2$.
[2] Measured between all pins.

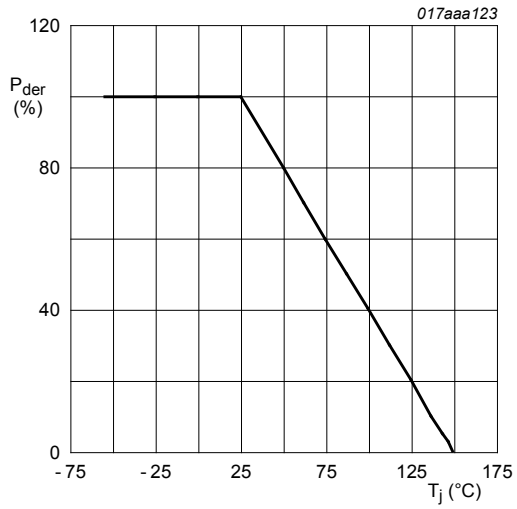



**Fig. 1. Normalized total power dissipation as a function of junction temperature**

$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\ \%$$

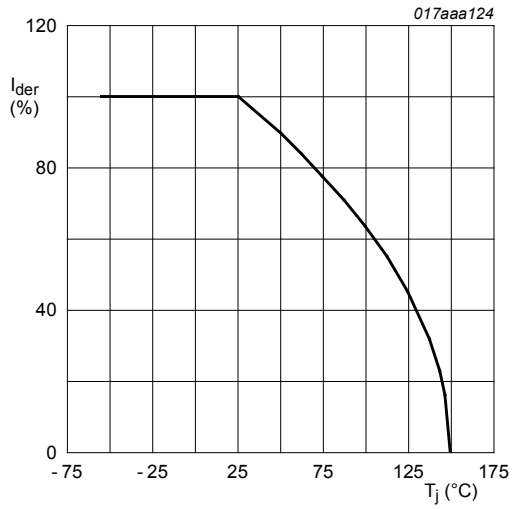
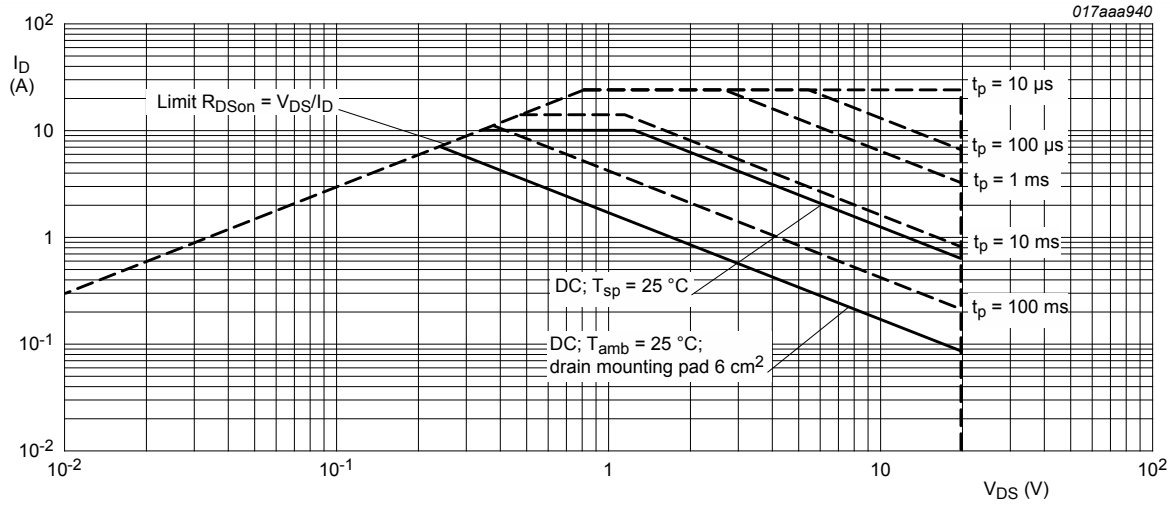



**Fig. 2. Normalized continuous drain current as a function of junction temperature**

$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\ \%$$




$I_{DM}$ = single pulse

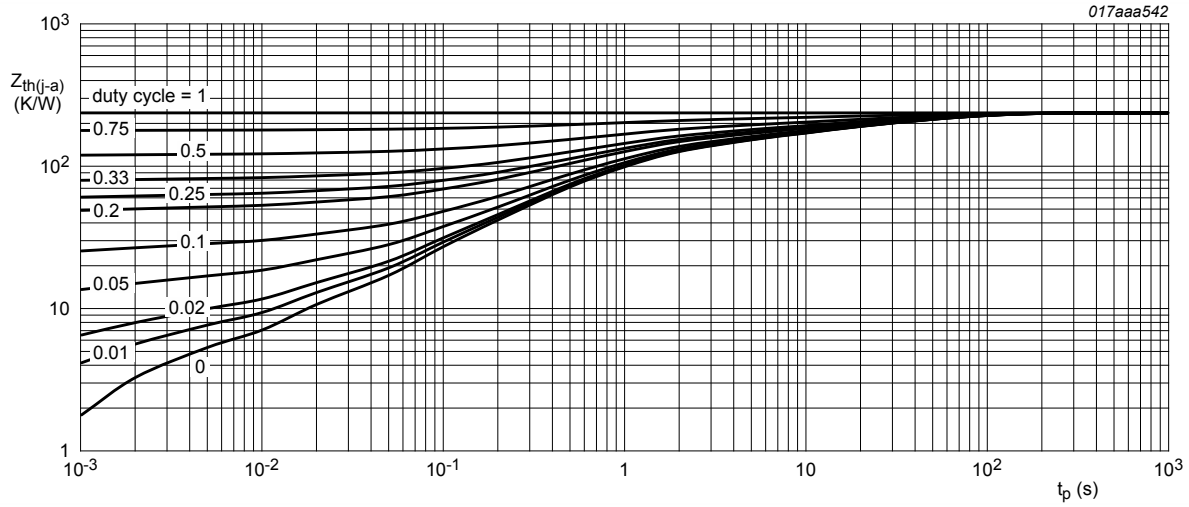
**Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage**

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

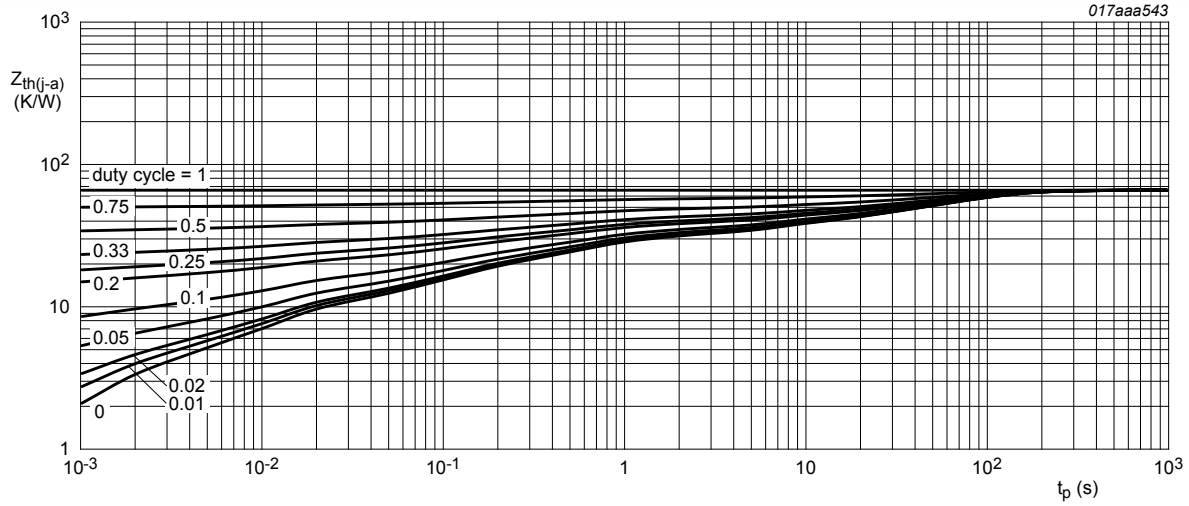
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | 235 | 270 | K/W |
| | | | [2] | - | 67 | 74 | K/W |
| | | in free air; t ≤ 5 s | [2] | - | 33 | 36 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | 5 | 10 | K/W |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 $cm^2$.




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 $cm^2$

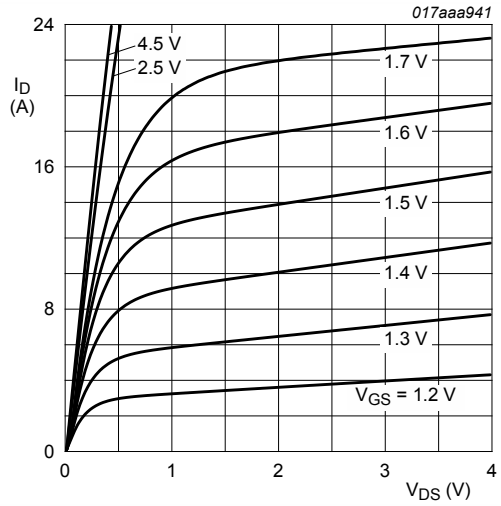
**Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

# 7. Characteristics

**Table 7. Characteristics**

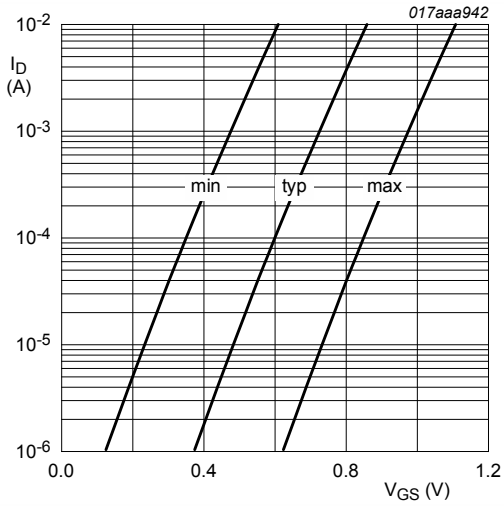
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | 20 | - | - | V |
| $V_{GSth}$ | gate-source threshold voltage | $I_D$ = 250 µA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C | | 0.4 | 0.65 | 0.9 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 20 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | - | 1 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 8 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 10 | µA |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{GS}$ = -8 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | -10 | µA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 4.5 V; $I_D$ = 7 A; $T_j$ = 25 °C | | - | 19 | 22 | mΩ |
| | | $V_{GS}$ = 4.5 V; $I_D$ = 7 A; $T_j$ = 150 °C | | - | 29 | 34 | mΩ |
| | | $V_{GS}$ = 2.5 V; $I_D$ = 6.1 A; $T_j$ = 25 °C | | - | 23 | 29 | mΩ |
| | | $V_{GS}$ = 1.8 V; $I_D$ = 1.9 A; $T_j$ = 25 °C | | - | 31 | 44 | mΩ |
| $g_{fs}$ | forward transconductance | $V_{DS}$ = 10 V; $I_D$ = 7 A; $T_j$ = 25 °C | | - | 50 | - | S |
| $R_G$ | gate resistance | f = 1 MHz; $T_j$ = 25 °C | | - | 2.4 | - | Ω |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS}$ = 10 V; $I_D$ = 6 A; $V_{GS}$ = 4.5 V; $T_j$ = 25 °C | | - | 11.6 | 17 | nC |
| $Q_{GS}$ | gate-source charge | | | - | 1.4 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 2.2 | - | nC |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 10 V; f = 1 MHz; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 1136 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 137 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 112 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 10 V; $I_D$ = 6 A; $V_{GS}$ = 4.5 V; $R_{G(ext)}$ = 6 Ω; $T_j$ = 25 °C | | - | 9 | - | ns |
| $t_r$ | rise time | | | - | 20 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 31 | - | ns |
| $t_f$ | fall time | | | - | 32 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 1.9 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 0.6 | 1.2 | V |



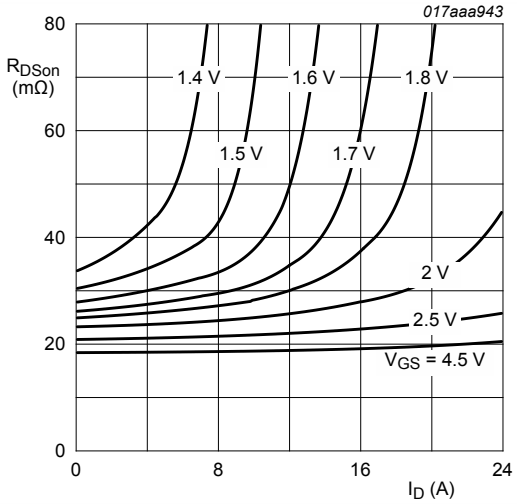

$T_j$ = 25 °C

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



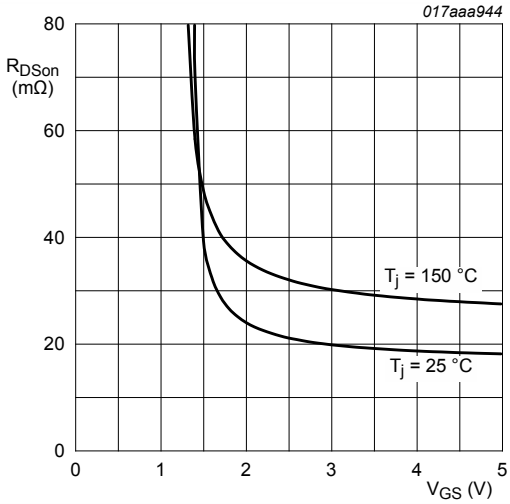

$T_j$ = 25 °C; $V_{DS}$ = 5 V

**Fig. 7. Subthreshold drain current as a function of gate-source voltage**



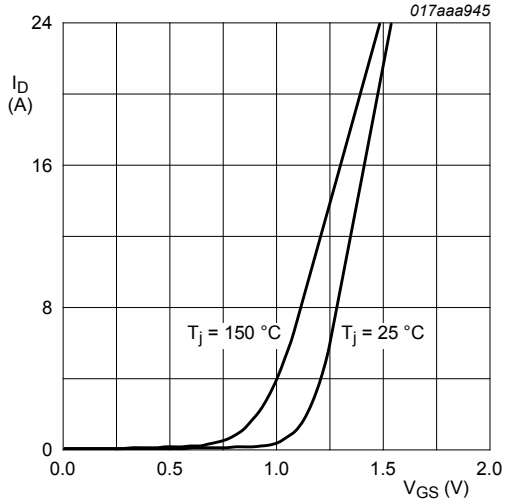

$T_j$ = 25 °C

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




$I_D$ = 7 A

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




$V_{DS} > I_D \times R_{DSon}$

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

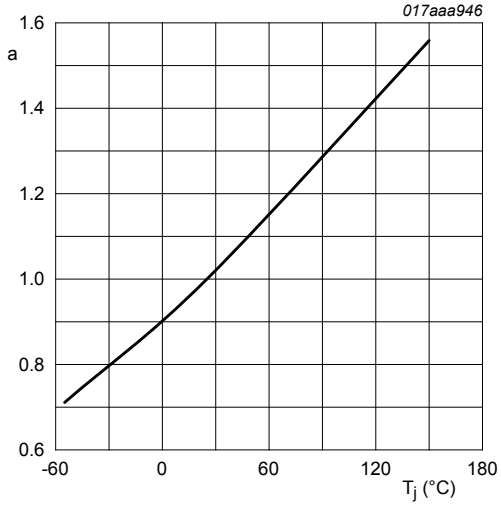
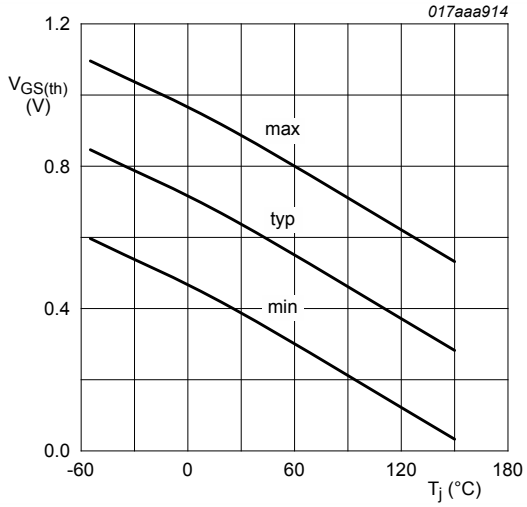


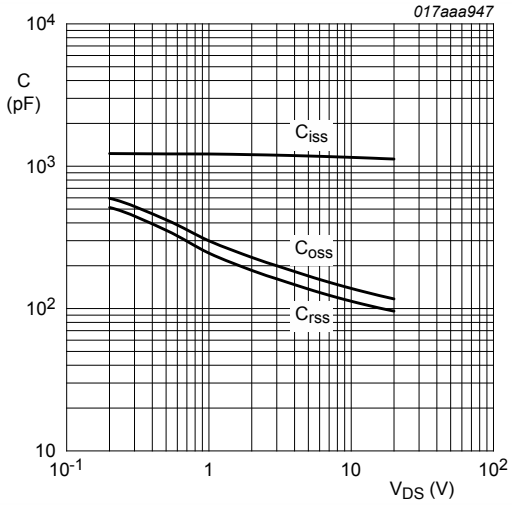

**Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values**

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$



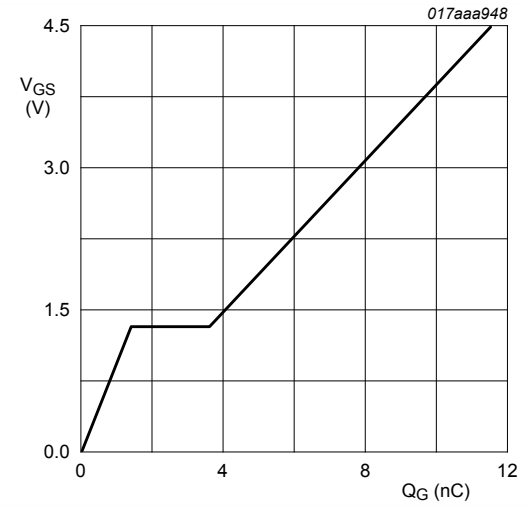

$I_D$ = 0.25 mA; $V_{DS}$ = $V_{GS}$

**Fig. 12. Gate-source threshold voltage as a function of junction temperature**



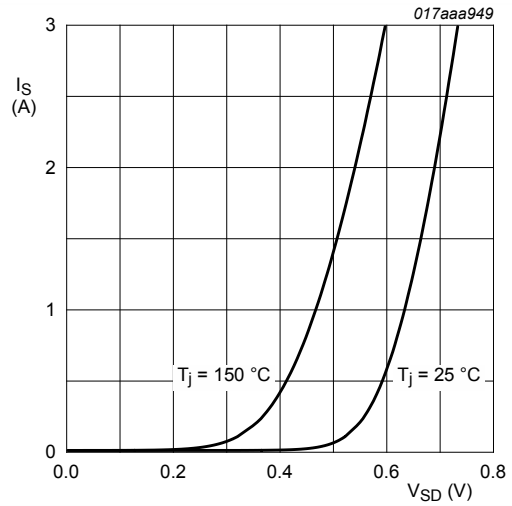

f = 1 MHz; $V_{GS}$ = 0 V

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




$I_D$ = 6 A; $V_{DS}$ = 10 V; $T_{amb}$ = 25 °C

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




$V_{GS}$ = 0 V

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

## 8. Test information

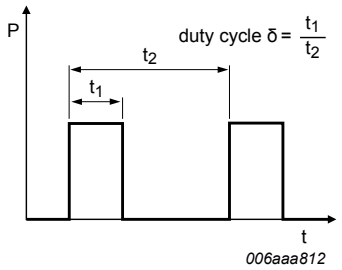



**Fig. 16. Duty cycle definition**

## 9. Package outline

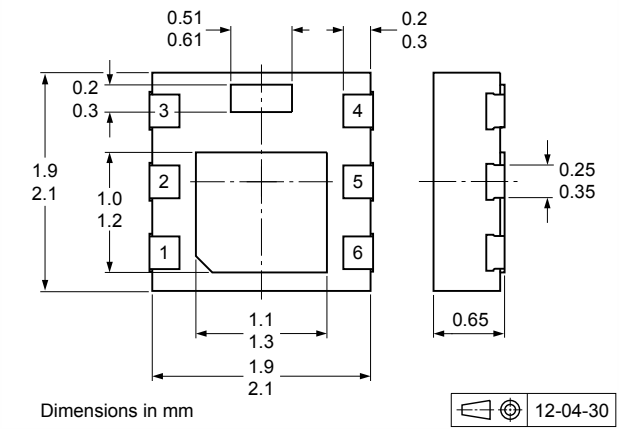



**Fig. 17. Package outline DFN2020MD-6 (SOT1220)**

## 10. Soldering

**Footprint information for reflow soldering of DFN2020MD-6 package** **SOT1220**

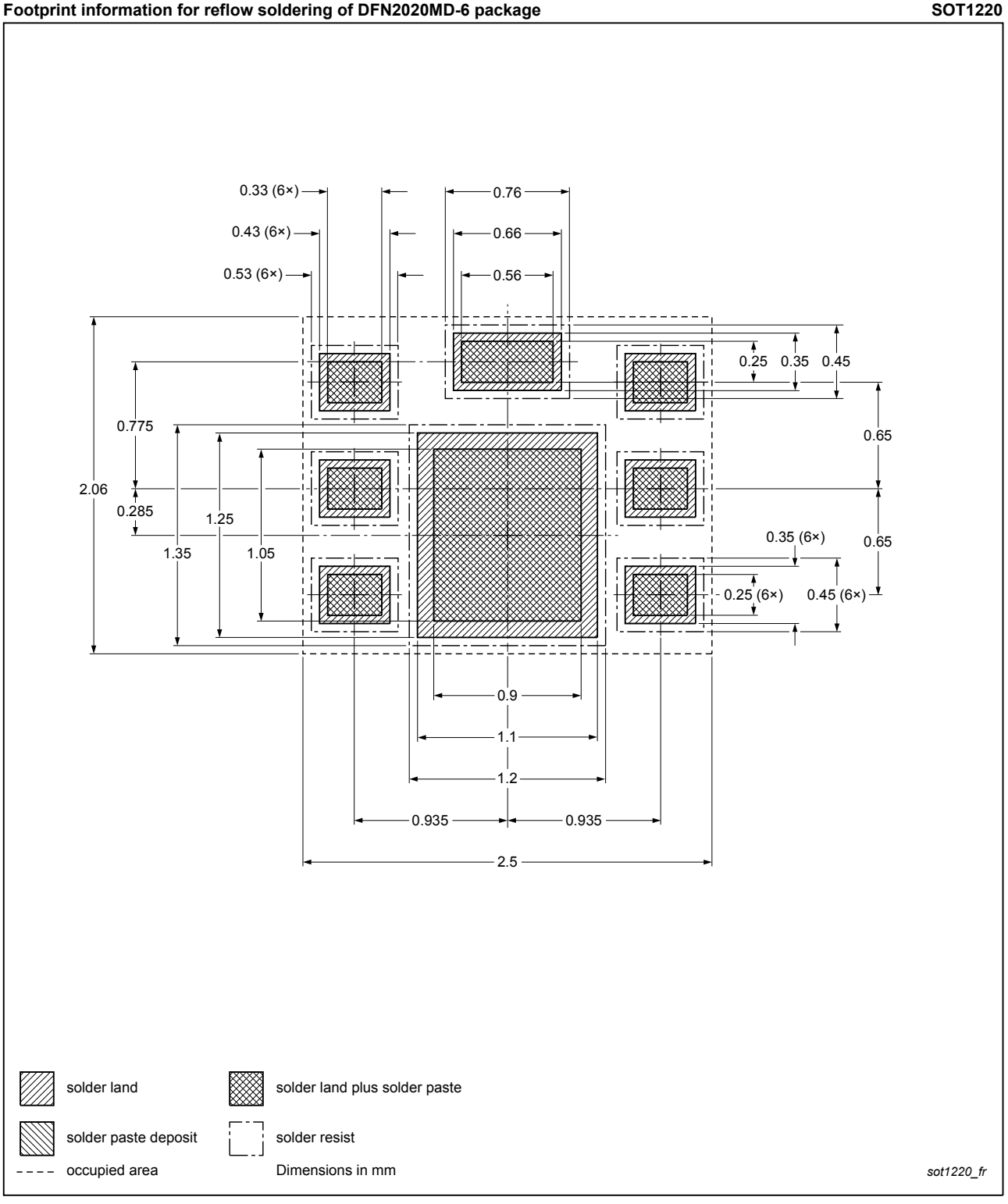



**Fig. 18. Reflow soldering footprint for DFN2020MD-6 (SOT1220)**

# 11. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PMPB23XNE v.1 | 20121130 | Product data sheet | - | - |

# 12. Legal information

## 12.1 Data sheet status

| Document status [1][2] | Product status [3] | Definition |
|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

[1] Please consult the most recently issued document before initiating or completing a design.
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**Date of release: 30 November 2012**

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