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Kind regards,

Team Nexperia

# PMPB15XP

12 V, single P-channel Trench MOSFET

22 November 2012

Product data sheet

## 1. Product profile

### 1.1 General description

P-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

- 1.5 kV ESD protection (human body model)
- Trench MOSFET technology
- 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 portable devices
- 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             | $T_J = 25\text{ }^{\circ}\text{C}$                                                      | -   | -   | -12   | V          |
| $V_{GS}$                      | gate-source voltage              |                                                                                         | -12 | -   | 12    | V          |
| $I_D$                         | drain current                    | $V_{GS} = -4.5\text{ V}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; $t \leq 5\text{ s}$ | [1] | -   | -11.8 | A          |
| <b>Static characteristics</b> |                                  |                                                                                         |     |     |       |            |
| $R_{DS(on)}$                  | drain-source on-state resistance | $V_{GS} = -4.5\text{ V}$ ; $I_D = -8.2\text{ A}$ ; $T_J = 25\text{ }^{\circ}\text{C}$   | -   | 15  | 19    | m $\Omega$ |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 6 cm<sup>2</sup>.

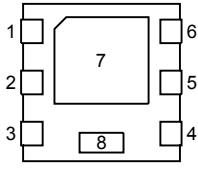
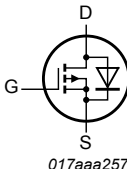


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## 2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                                                                             | Graphic symbol                                                                                       |
|-----|--------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 1   | D      | drain       |  <p>Transparent top view<br/><b>DFN2020MD-6 (SOT1220)</b></p> |  <p>017aaa257</p> |
| 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 |
| PMPB15XP    | 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 |
|-------------|--------------|
| PMPB15XP    | 1A           |

## 5. Limiting values

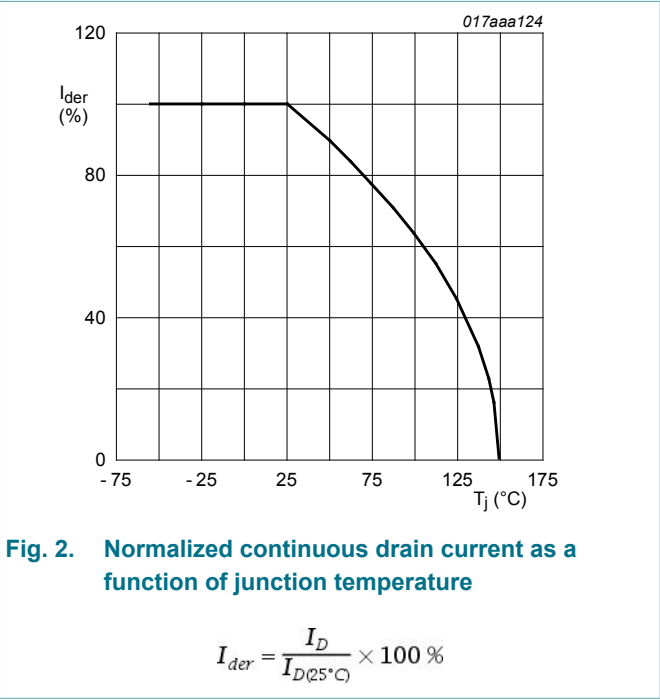
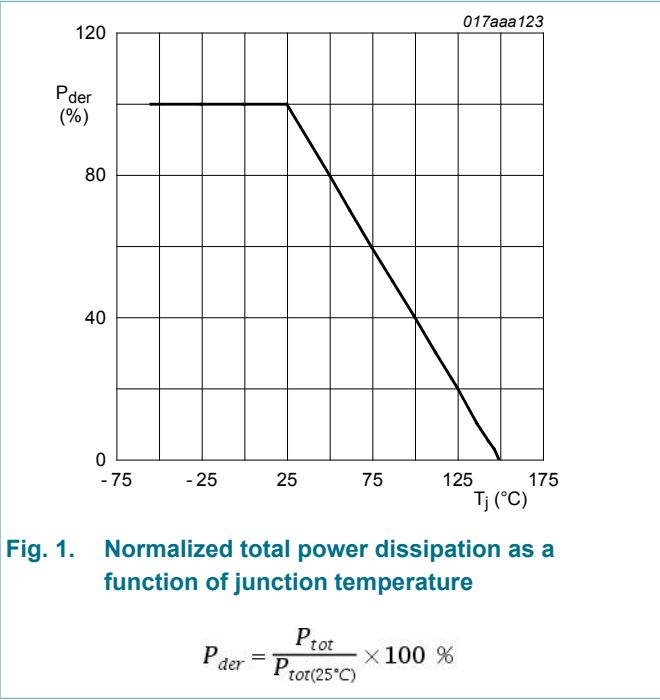
Table 5. Limiting values

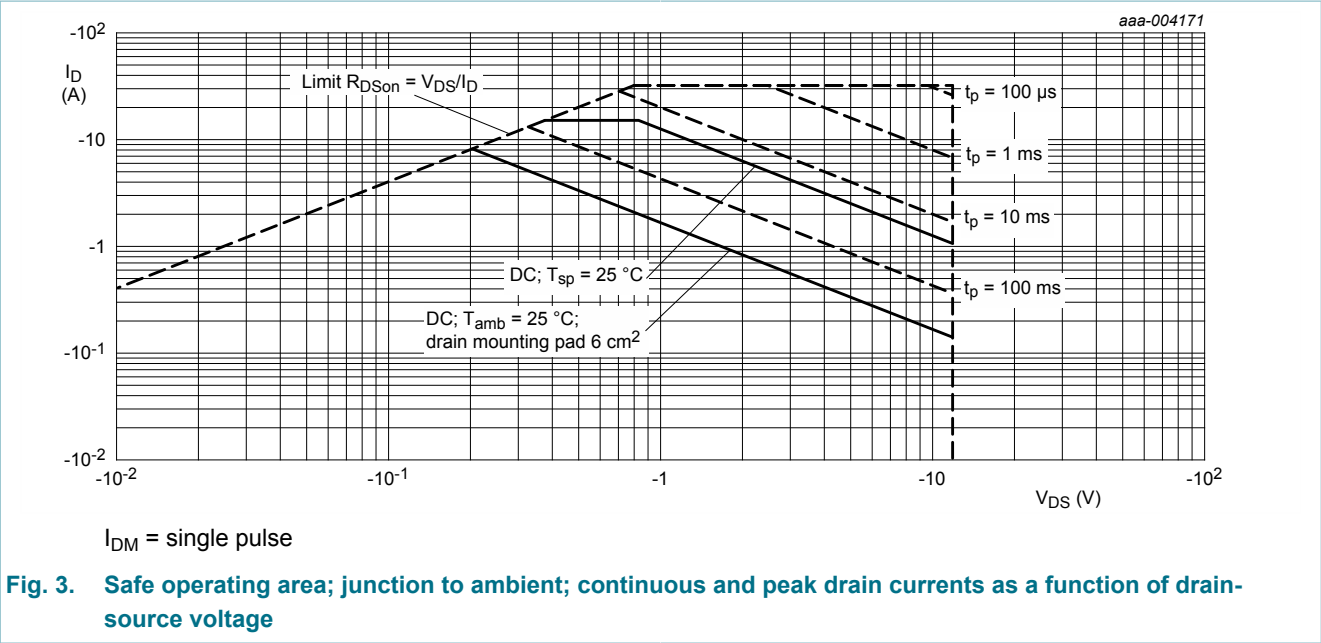
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol    | Parameter               | Conditions                                                                              |     | Min | Max   | Unit |
|-----------|-------------------------|-----------------------------------------------------------------------------------------|-----|-----|-------|------|
| $V_{DS}$  | drain-source voltage    | $T_j = 25\text{ }^{\circ}\text{C}$                                                      |     | -   | -12   | V    |
| $V_{GS}$  | gate-source voltage     |                                                                                         |     | -12 | 12    | V    |
| $I_D$     | drain current           | $V_{GS} = -4.5\text{ V}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; $t \leq 5\text{ s}$ | [1] | -   | -11.8 | A    |
|           |                         | $V_{GS} = -4.5\text{ V}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$                       | [1] | -   | -8.2  | A    |
|           |                         | $V_{GS} = -4.5\text{ V}$ ; $T_{amb} = 100\text{ }^{\circ}\text{C}$                      | [1] | -   | -5.2  | A    |
| $I_{DM}$  | peak drain current      | $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; single pulse; $t_p \leq 10\text{ }\mu\text{s}$ |     | -   | -33   | A    |
| $P_{tot}$ | total power dissipation | $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                  | [1] | -   | 1.7   | W    |

| Symbol             | Parameter            | Conditions                        |     | Min | Max  | Unit |
|--------------------|----------------------|-----------------------------------|-----|-----|------|------|
|                    |                      | T <sub>amb</sub> = 25 °C; t ≤ 5 s | [1] | -   | 3.5  | W    |
|                    |                      | T <sub>sp</sub> = 25 °C           |     | -   | 12.5 | W    |
| T <sub>j</sub>     | junction temperature |                                   |     | -55 | 150  | °C   |
| T <sub>amb</sub>   | ambient temperature  |                                   |     | -55 | 150  | °C   |
| T <sub>stg</sub>   | storage temperature  |                                   |     | -65 | 150  | °C   |
| Source-drain diode |                      |                                   |     |     |      |      |
| I <sub>S</sub>     | source current       | T <sub>amb</sub> = 25 °C          | [1] | -   | -1.9 | A    |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 6 cm<sup>2</sup>.



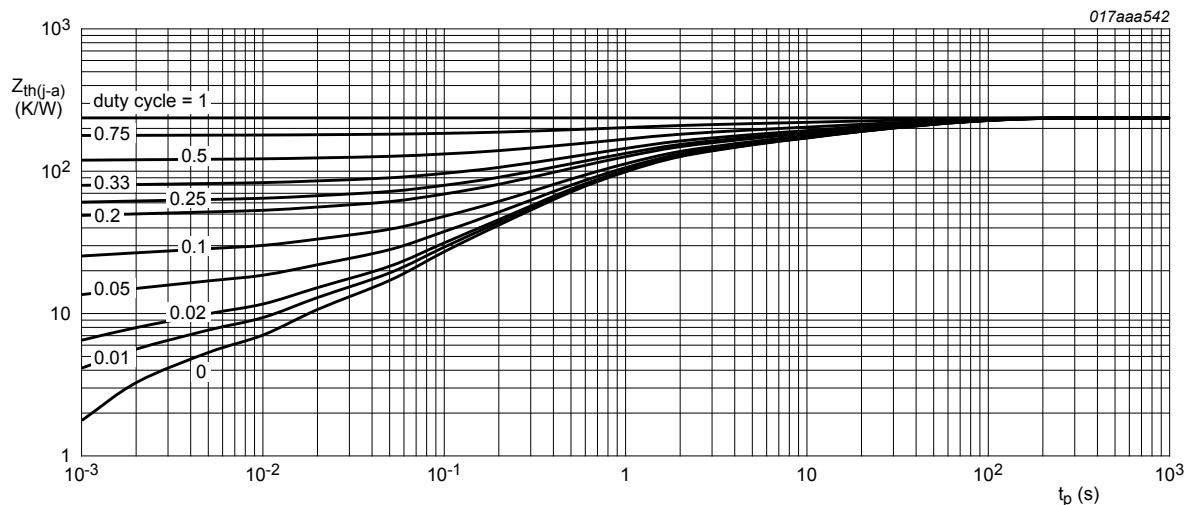


6. Thermal characteristics

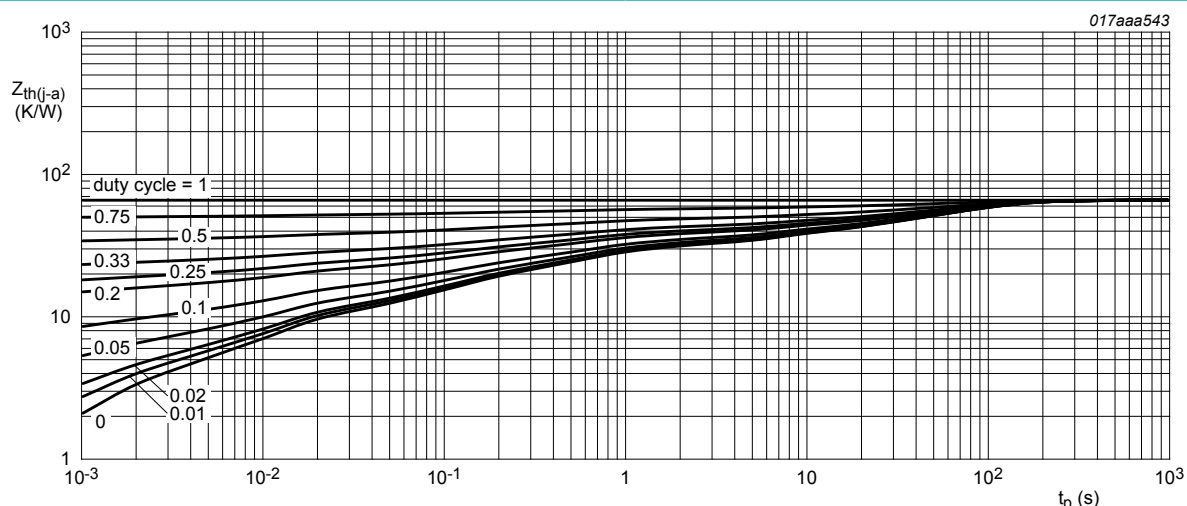
Table 6. Thermal characteristics

| 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; $t \leq 5 s$ | [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  $6 cm^2$ .



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



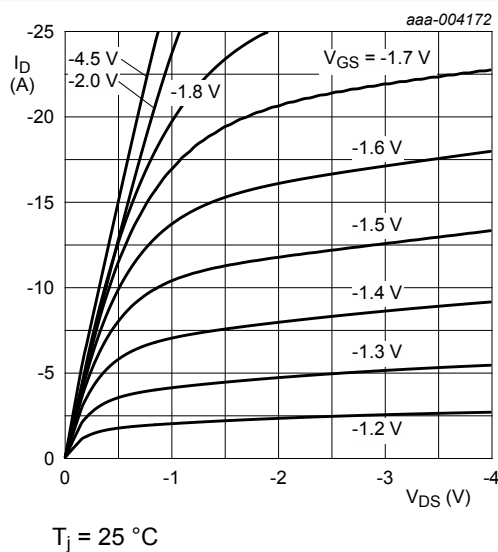
**Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

## 7. Characteristics

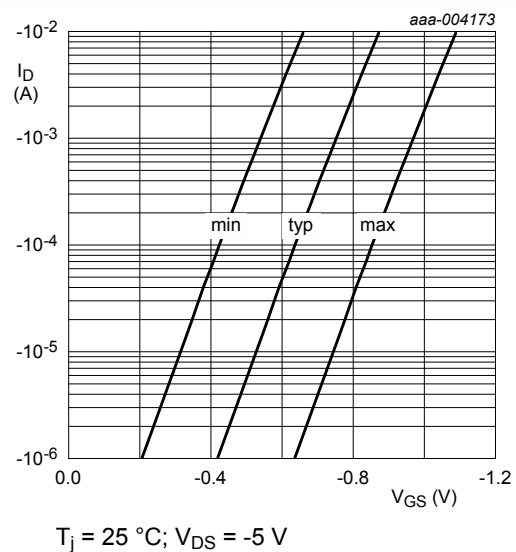
**Table 7. Characteristics**

| Symbol                        | Parameter                      | Conditions                                                   | Min   | Typ   | Max  | Unit    |
|-------------------------------|--------------------------------|--------------------------------------------------------------|-------|-------|------|---------|
| <b>Static characteristics</b> |                                |                                                              |       |       |      |         |
| $V_{(BR)DSS}$                 | drain-source breakdown voltage | $I_D = -250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 ^\circ C$    | -12   | -     | -    | V       |
| $V_{GSth}$                    | gate-source threshold voltage  | $I_D = -250 \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 ^\circ C$ | -0.47 | -0.68 | -0.9 | V       |
| $I_{DSS}$                     | drain leakage current          | $V_{DS} = -12 V$ ; $V_{GS} = 0 V$ ; $T_j = 25 ^\circ C$      | -     | -     | -1   | $\mu A$ |
|                               |                                | $V_{DS} = -12 V$ ; $V_{GS} = 0 V$ ; $T_j = 150 ^\circ C$     | -     | -     | -100 | $\mu A$ |

| Symbol                  | Parameter                        | Conditions                                                                                                                   |  | Min | Typ  | Max  | Unit |
|-------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------|--|-----|------|------|------|
| I <sub>GSS</sub>        | gate leakage current             | V <sub>GS</sub> = -12 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                       |  | -   | -    | -100 | nA   |
|                         |                                  | V <sub>GS</sub> = 12 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                        |  | -   | -    | -100 | nA   |
| R <sub>DSon</sub>       | drain-source on-state resistance | V <sub>GS</sub> = -4.5 V; I <sub>D</sub> = -8.2 A; T <sub>j</sub> = 25 °C                                                    |  | -   | 15   | 19   | mΩ   |
|                         |                                  | V <sub>GS</sub> = -4.5 V; I <sub>D</sub> = -8.2 A; T <sub>j</sub> = 150 °C                                                   |  | -   | 20   | 25   | mΩ   |
|                         |                                  | V <sub>GS</sub> = -2.5 V; I <sub>D</sub> = -3.9 A; T <sub>j</sub> = 25 °C                                                    |  | -   | 17   | 20   | mΩ   |
|                         |                                  | V <sub>GS</sub> = -1.8 V; I <sub>D</sub> = -3.9 A; T <sub>j</sub> = 25 °C                                                    |  | -   | 21   | 33   | mΩ   |
| g <sub>fs</sub>         | forward transconductance         | V <sub>DS</sub> = -10 V; I <sub>D</sub> = -8.2 A; T <sub>j</sub> = 25 °C                                                     |  | -   | 40   | -    | S    |
| Dynamic characteristics |                                  |                                                                                                                              |  |     |      |      |      |
| Q <sub>G(tot)</sub>     | total gate charge                | V <sub>DS</sub> = -6 V; I <sub>D</sub> = -8.2 A; V <sub>GS</sub> = -4.5 V; T <sub>j</sub> = 25 °C                            |  | -   | 67   | 100  | nC   |
| Q <sub>GS</sub>         | gate-source charge               |                                                                                                                              |  | -   | 5.5  | -    | nC   |
| Q <sub>GD</sub>         | gate-drain charge                |                                                                                                                              |  | -   | 7.3  | -    | nC   |
| C <sub>iss</sub>        | input capacitance                | V <sub>DS</sub> = -6 V; f = 1 MHz; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                             |  | -   | 2875 | -    | pF   |
| C <sub>oss</sub>        | output capacitance               |                                                                                                                              |  | -   | 570  | -    | pF   |
| C <sub>rss</sub>        | reverse transfer capacitance     |                                                                                                                              |  | -   | 530  | -    | pF   |
| t <sub>d(on)</sub>      | turn-on delay time               | V <sub>DS</sub> = -6 V; I <sub>D</sub> = -8.2 A; V <sub>GS</sub> = -4.5 V; R <sub>G(ext)</sub> = 6 Ω; T <sub>j</sub> = 25 °C |  | -   | 18   | -    | ns   |
| t <sub>r</sub>          | rise time                        |                                                                                                                              |  | -   | 90   | -    | ns   |
| t <sub>d(off)</sub>     | turn-off delay time              |                                                                                                                              |  | -   | 85   | -    | ns   |
| t <sub>f</sub>          | fall time                        |                                                                                                                              |  | -   | 57   | -    | ns   |
| Source-drain diode      |                                  |                                                                                                                              |  |     |      |      |      |
| V <sub>SD</sub>         | source-drain voltage             | I <sub>S</sub> = -1.9 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °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**

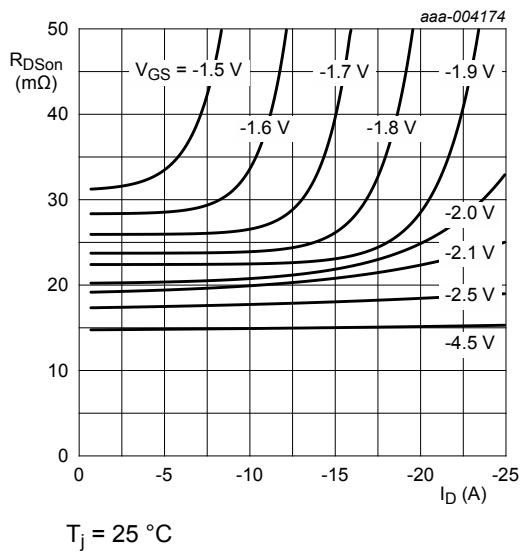


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

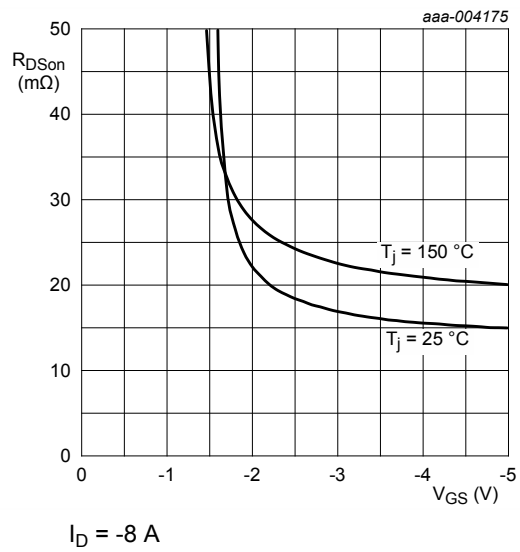


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

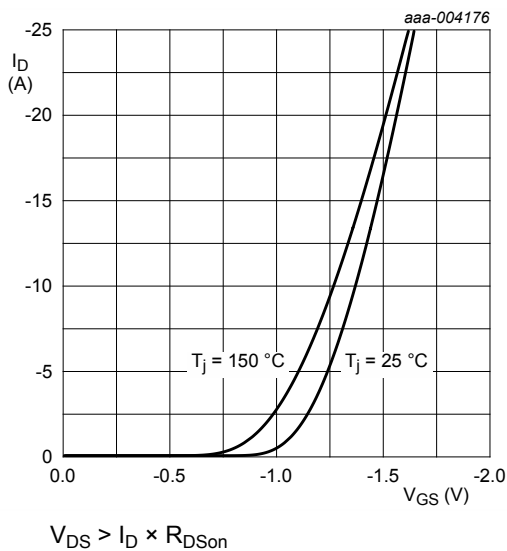


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

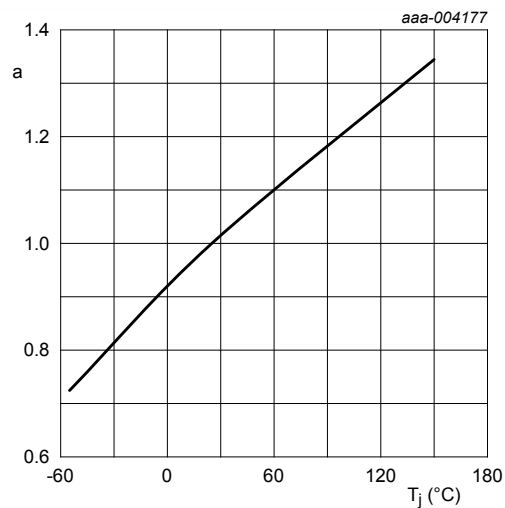


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

$$a = \frac{R_{DS(on)}}{R_{DS(on)(25^{\circ}\text{C})}}$$

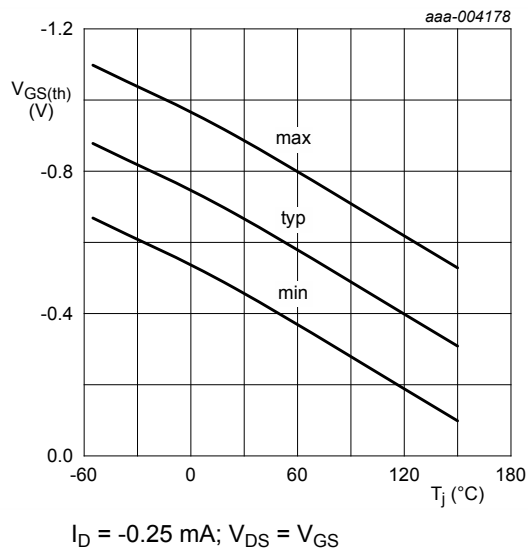


Fig. 12. Gate-source threshold voltage as a function of junction temperature

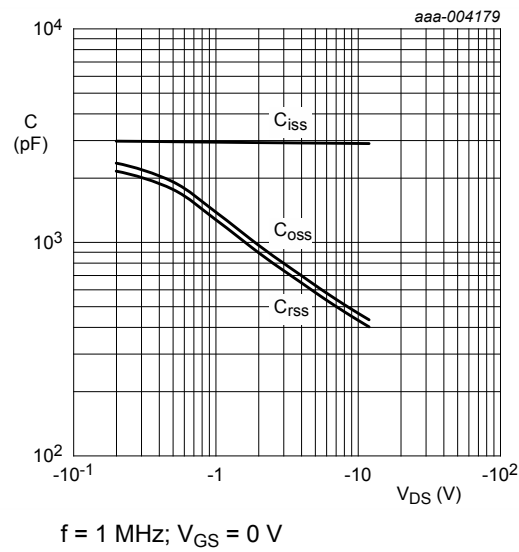


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

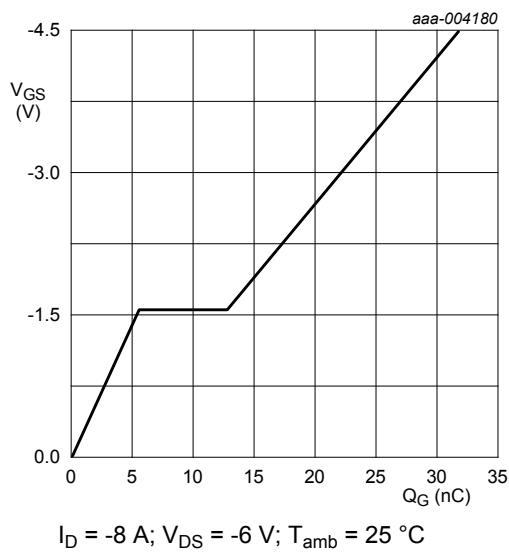


Fig. 14. Gate-source voltage as a function of gate charge; typical values

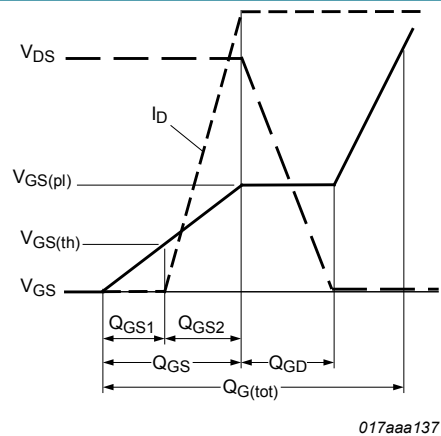
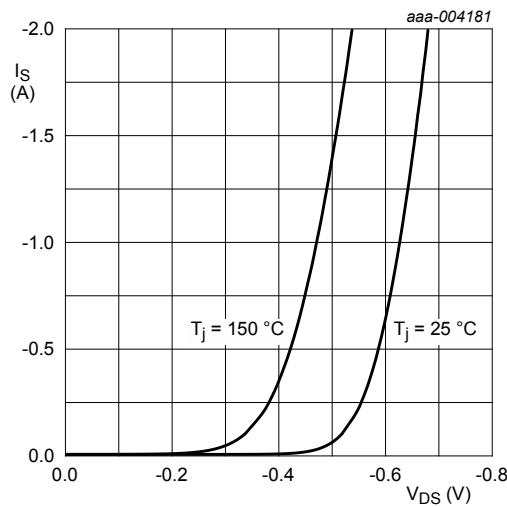


Fig. 15. Gate charge waveform definitions



$V_{GS} = 0\text{ V}$

Fig. 16. Source current as a function of source-drain voltage; typical values

8. Test information

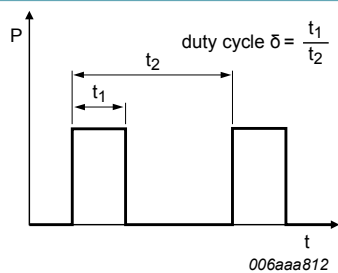


Fig. 17. Duty cycle definition

9. Package outline

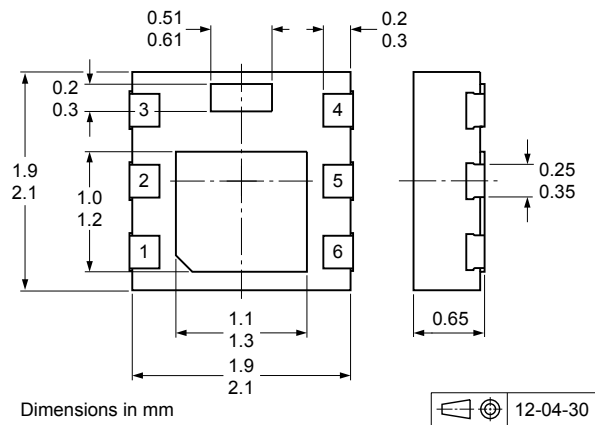


Fig. 18. Package outline DFN2020MD-6 (SOT1220)

10. Soldering

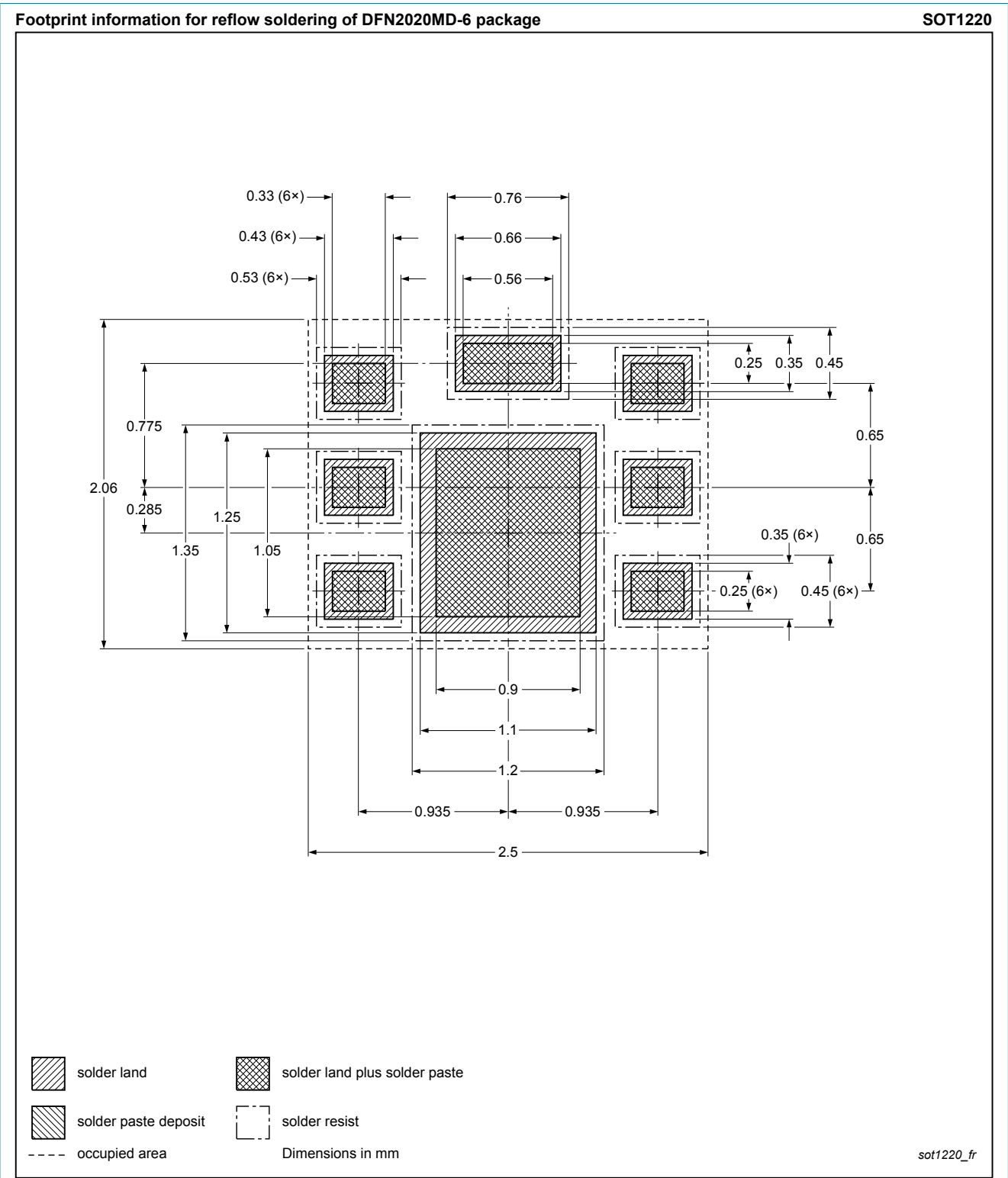


Fig. 19. Reflow soldering footprint for DFN2020MD-6 (SOT1220)

## 11. Revision history

Table 8. Revision history

| Data sheet ID  | Release date                                                                                                                                | Data sheet status      | Change notice | Supersedes   |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------|--------------|
| PMPB15XP v.3   | 20121122                                                                                                                                    | Product data sheet     | -             | PMPB15XP v.2 |
| Modifications: | <ul style="list-style-type: none"><li>Table 7 "Characteristics": <math>R_{DSon}</math> at <math>V_{GS} = -1.8</math> V corrected.</li></ul> |                        |               |              |
| PMPB15XP v.2   | 20120719                                                                                                                                    | Product data sheet     | -             | PMPB15XP v.1 |
| PMPB15XP v.1   | 20120706                                                                                                                                    | Preliminary 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.
- [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.nxp.com>.

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