

# PMPB20EN

## 30 V N-channel Trench MOSFET

Rev. 1 — 16 May 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

- Trench MOSFET technology
- Very fast switching
- 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

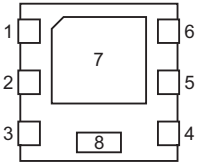
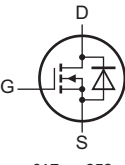
| Symbol                        | Parameter                        | Conditions                                                              | Min                 | Typ  | Max  | Unit |
|-------------------------------|----------------------------------|-------------------------------------------------------------------------|---------------------|------|------|------|
| $V_{DS}$                      | drain-source voltage             | $T_j = 25\text{ °C}$                                                    | -                   | -    | 30   | V    |
| $V_{GS}$                      | gate-source voltage              |                                                                         | -20                 | -    | 20   | V    |
| $I_D$                         | drain current                    | $V_{GS} = 10\text{ V}$ ; $T_{amb} = 25\text{ °C}$ ; $t \leq 5\text{ s}$ | <a href="#">[1]</a> | -    | 10.4 | A    |
| <b>Static characteristics</b> |                                  |                                                                         |                     |      |      |      |
| $R_{DS(on)}$                  | drain-source on-state resistance | $V_{GS} = 10\text{ V}$ ; $I_D = 7\text{ A}$ ; $T_j = 25\text{ °C}$      | -                   | 16.5 | 19.5 | mΩ   |

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



2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                                                                        | Graphic symbol                                                                                   |
|-----|--------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 1   | D      | drain       | <br>Transparent top view<br><b>SOT1220 (DFN2020MD-6)</b> | <br>017aaa253 |
| 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     |                                                                                  | Version |
|-------------|-------------|----------------------------------------------------------------------------------|---------|
|             | Name        | Description                                                                      |         |
| PMPB20EN    | 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 |
|-------------|--------------|
| PMPB20EN    | 1B           |

## 5. Limiting values

**Table 5. Limiting values**

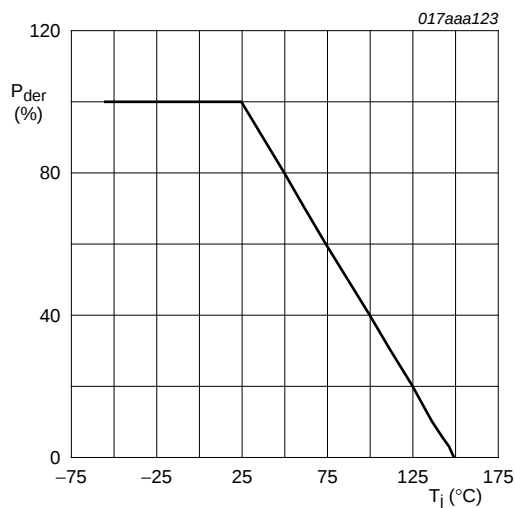
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol    | Parameter               | Conditions                                                                                  | Min | Max  | Unit               |
|-----------|-------------------------|---------------------------------------------------------------------------------------------|-----|------|--------------------|
| $V_{DS}$  | drain-source voltage    | $T_j = 25\text{ }^{\circ}\text{C}$                                                          | -   | 30   | V                  |
| $V_{GS}$  | gate-source voltage     |                                                                                             | -20 | 20   | V                  |
| $I_D$     | drain current           | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}; t \leq 5\text{ s}$             | [1] | 10.4 | A                  |
|           |                         | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$                                | [1] | 7.2  | A                  |
|           |                         | $V_{GS} = 10\text{ V}; T_{amb} = 100\text{ }^{\circ}\text{C}$                               | [1] | 4.6  | A                  |
| $I_{DM}$  | peak drain current      | $T_{amb} = 25\text{ }^{\circ}\text{C}; \text{single pulse}; t_p \leq 10\text{ }\mu\text{s}$ | -   | 30   | A                  |
| $P_{tot}$ | total power dissipation | $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                      | [1] | 1.7  | W                  |
|           |                         | $T_{amb} = 25\text{ }^{\circ}\text{C}; t \leq 5\text{ s}$                                   | [1] | 3.5  | W                  |
|           |                         | $T_{sp} = 25\text{ }^{\circ}\text{C}$                                                       | -   | 12.5 | W                  |
| $T_j$     | junction temperature    |                                                                                             | -55 | 150  | $^{\circ}\text{C}$ |
| $T_{amb}$ | ambient temperature     |                                                                                             | -55 | 150  | $^{\circ}\text{C}$ |
| $T_{stg}$ | storage temperature     |                                                                                             | -65 | 150  | $^{\circ}\text{C}$ |

### Source-drain diode

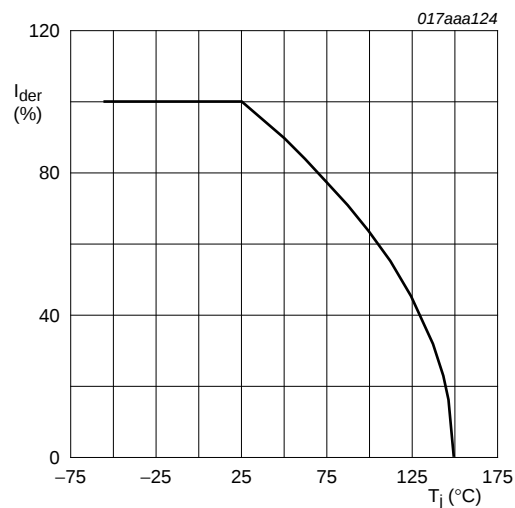
|       |                |                                        |     |     |   |
|-------|----------------|----------------------------------------|-----|-----|---|
| $I_S$ | source current | $T_{amb} = 25\text{ }^{\circ}\text{C}$ | [1] | 2.2 | A |
|-------|----------------|----------------------------------------|-----|-----|---|

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



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

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



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

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

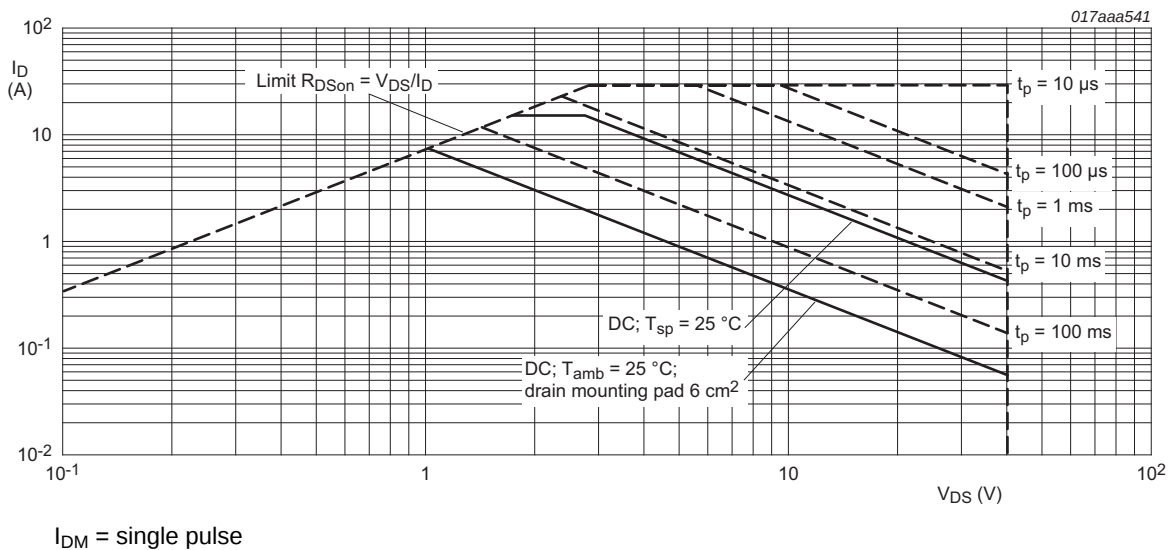


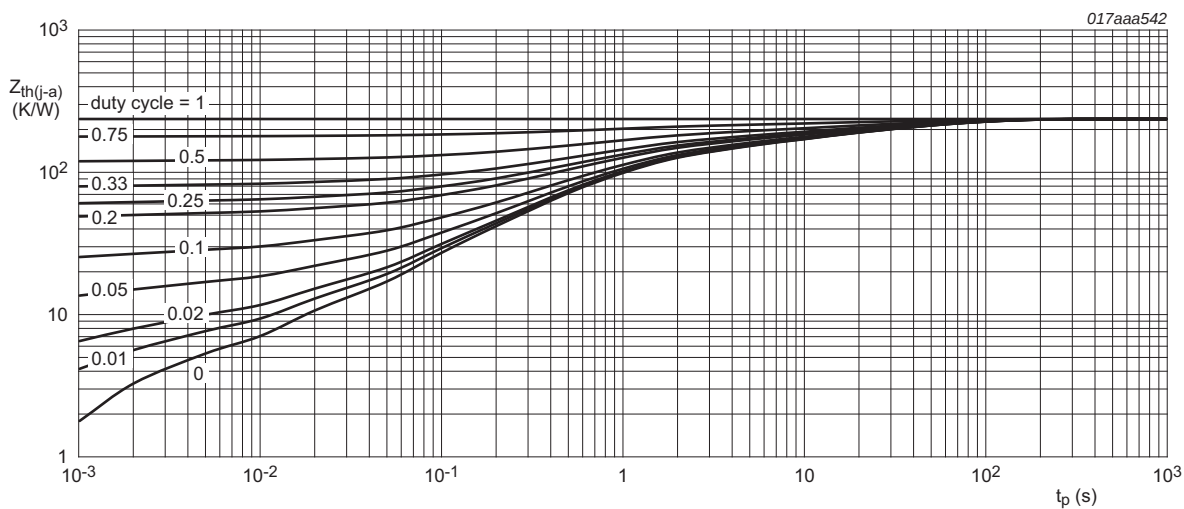
Fig 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

6. Thermal characteristics

Table 6. Thermal characteristics

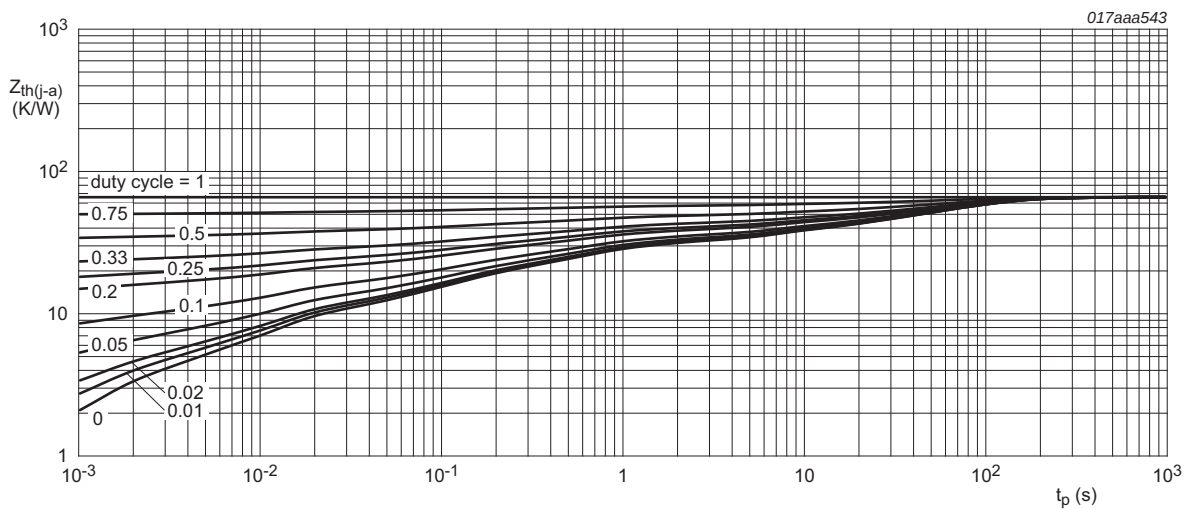
| Symbol         | Parameter                                        | Conditions  | Min | Typ | Max | Unit |
|----------------|--------------------------------------------------|-------------|-----|-----|-----|------|
| $R_{th(j-a)}$  | thermal resistance from junction to ambient      | in free air | [1] | -   | 235 | K/W  |
|                |                                                  |             | [2] | -   | 67  | K/W  |
|                |                                                  |             | [3] | -   | 33  | 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  $6\text{ cm}^2$ .
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain  $6\text{ cm}^2$ ,  $t \leq 5\text{ s}$



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<sup>2</sup>

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   | $I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                             | 30  | -    | -    | V          |
| $V_{GSth}$                     | gate-source threshold voltage    | $I_D = 250\ \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25\ ^\circ C$                                           | 1   | 1.5  | 2    | V          |
| $I_{DSS}$                      | drain leakage current            | $V_{DS} = 30\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                               | -   | -    | 1    | $\mu A$    |
|                                |                                  | $V_{DS} = 30\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 150\ ^\circ C$                                              | -   | -    | 20   | $\mu A$    |
| $I_{GSS}$                      | gate leakage current             | $V_{GS} = 20\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                               | -   | -    | 100  | nA         |
|                                |                                  | $V_{GS} = -20\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                              | -   | -    | 100  | nA         |
| $R_{DSon}$                     | drain-source on-state resistance | $V_{GS} = 10\ V$ ; $I_D = 7\ A$ ; $T_j = 25\ ^\circ C$                                                  | -   | 16.5 | 19.5 | m $\Omega$ |
|                                |                                  | $V_{GS} = 10\ V$ ; $I_D = 7\ A$ ; $T_j = 150\ ^\circ C$                                                 | -   | 27   | 32   | m $\Omega$ |
|                                |                                  | $V_{GS} = 4.5\ V$ ; $I_D = 7\ A$ ; $T_j = 25\ ^\circ C$                                                 | -   | 20.5 | 24.5 | m $\Omega$ |
| $g_{fs}$                       | forward transconductance         | $V_{DS} = 10\ V$ ; $I_D = 7\ A$ ; $T_j = 25\ ^\circ C$                                                  | -   | 8    | -    | S          |
| $R_G$                          | gate resistance                  | $f = 1\ MHz$                                                                                            | -   | 1.7  | -    | $\Omega$   |
| <b>Dynamic characteristics</b> |                                  |                                                                                                         |     |      |      |            |
| $Q_{G(tot)}$                   | total gate charge                | $V_{DS} = 15\ V$ ; $I_D = 5\ A$ ; $V_{GS} = 10\ V$ ; $T_j = 25\ ^\circ C$                               | -   | 7.2  | 10.8 | nC         |
| $Q_{GS}$                       | gate-source charge               |                                                                                                         | -   | 1    | -    | nC         |
| $Q_{GD}$                       | gate-drain charge                |                                                                                                         | -   | 0.67 | -    | nC         |
| $C_{iss}$                      | input capacitance                | $V_{DS} = 10\ V$ ; $f = 1\ MHz$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                | -   | 435  | -    | pF         |
| $C_{oss}$                      | output capacitance               |                                                                                                         | -   | 90   | -    | pF         |
| $C_{rss}$                      | reverse transfer capacitance     |                                                                                                         | -   | 35   | -    | pF         |
| $t_{d(on)}$                    | turn-on delay time               | $V_{DS} = 15\ V$ ; $I_D = 5\ A$ ; $V_{GS} = 4.5\ V$ ; $R_{G(ext)} = 1.7\ \Omega$ ; $T_j = 25\ ^\circ C$ | -   | 9    | -    | ns         |
| $t_r$                          | rise time                        |                                                                                                         | -   | 17   | -    | ns         |
| $t_{d(off)}$                   | turn-off delay time              |                                                                                                         | -   | 9    | -    | ns         |
| $t_f$                          | fall time                        |                                                                                                         | -   | 8    | -    | ns         |
| <b>Source-drain diode</b>      |                                  |                                                                                                         |     |      |      |            |
| $V_{SD}$                       | source-drain voltage             | $I_S = 2.2\ A$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                 | -   | 0.8  | 1.2  | V          |

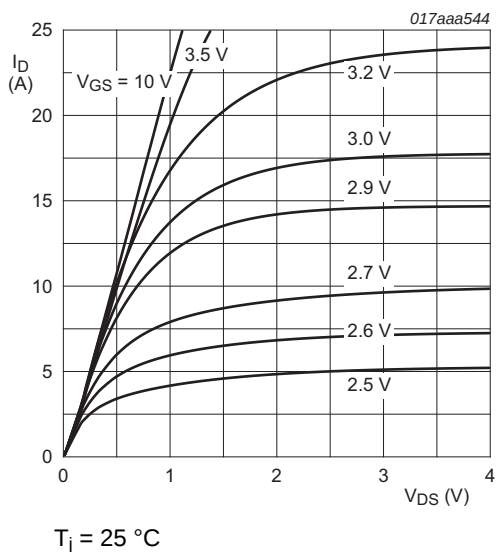


Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values

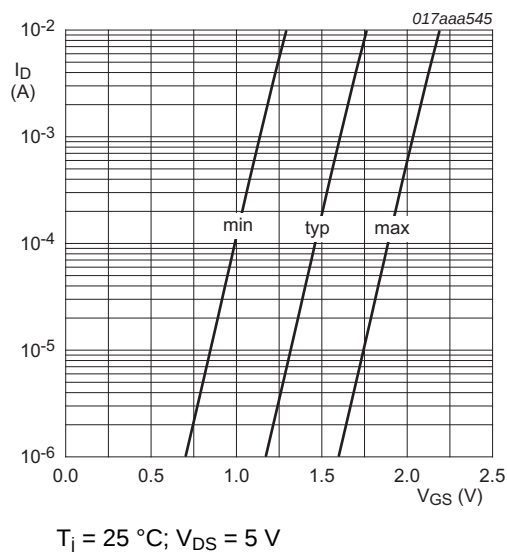


Fig 7. Sub-threshold drain current as a function of gate-source voltage

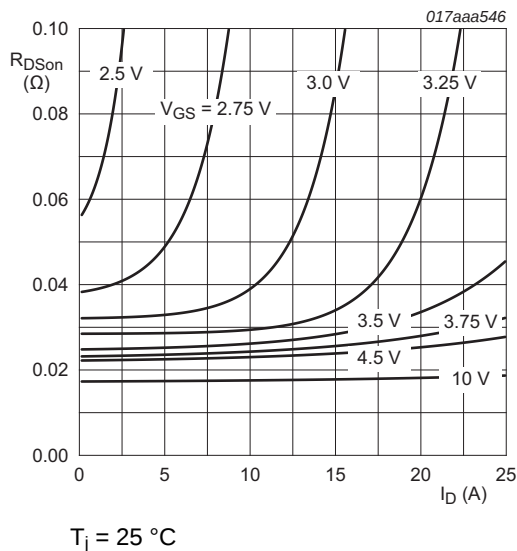


Fig 8. Drain-source on-state resistance as a function of drain current; typical values

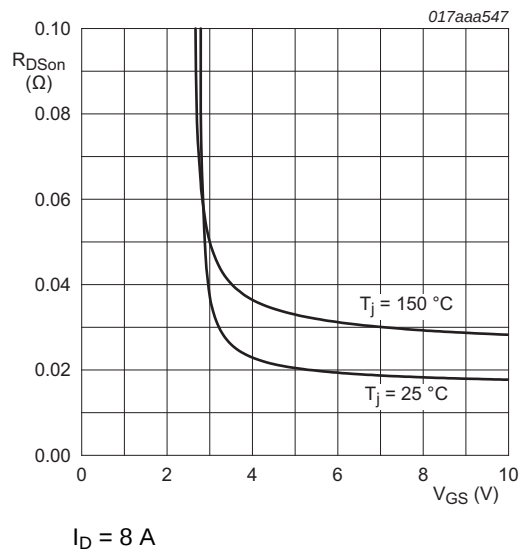


Fig 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

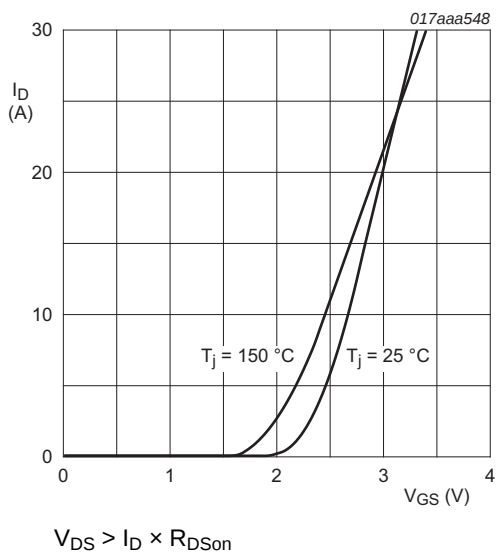


Fig 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

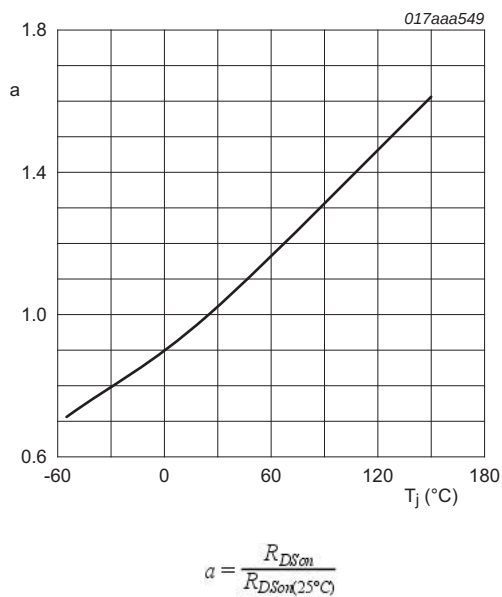
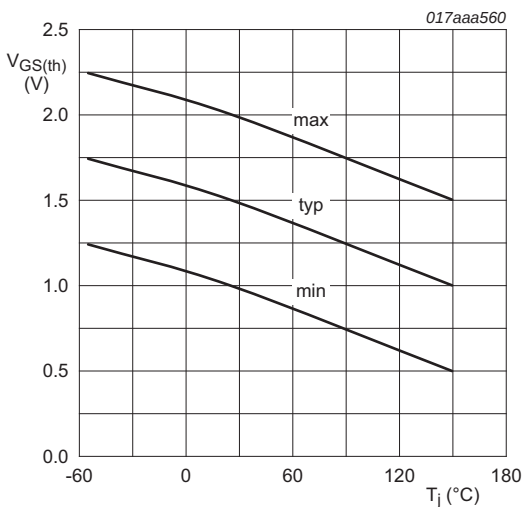
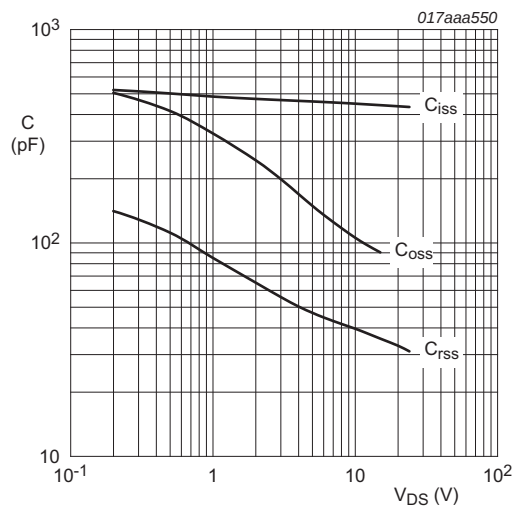


Fig 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values



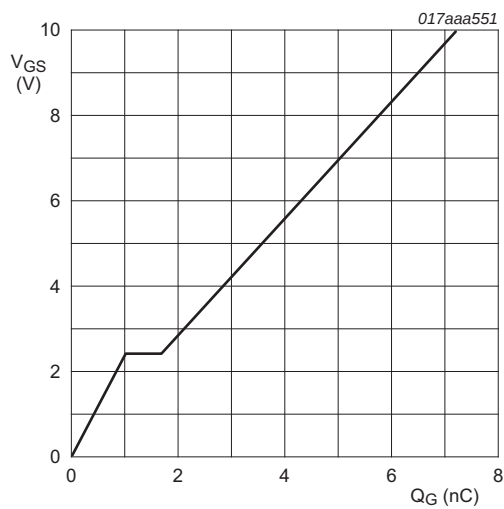
$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$

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



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

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



$I_D = 5\text{ A}$ ;  $V_{DS} = 15\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$

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

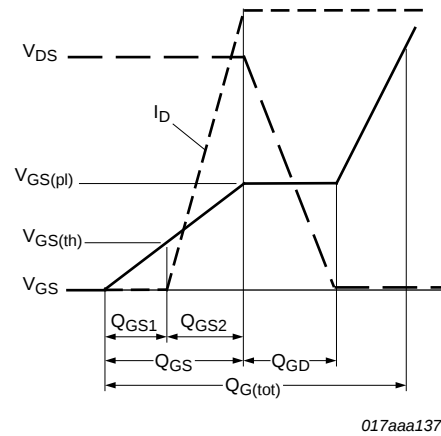
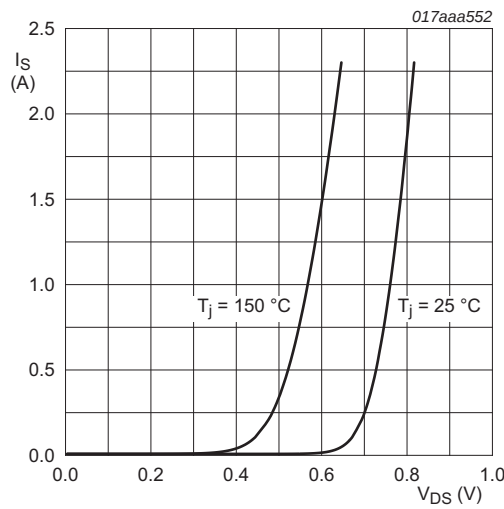


Fig 15. Gate charge waveform definitions



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

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



10. Soldering

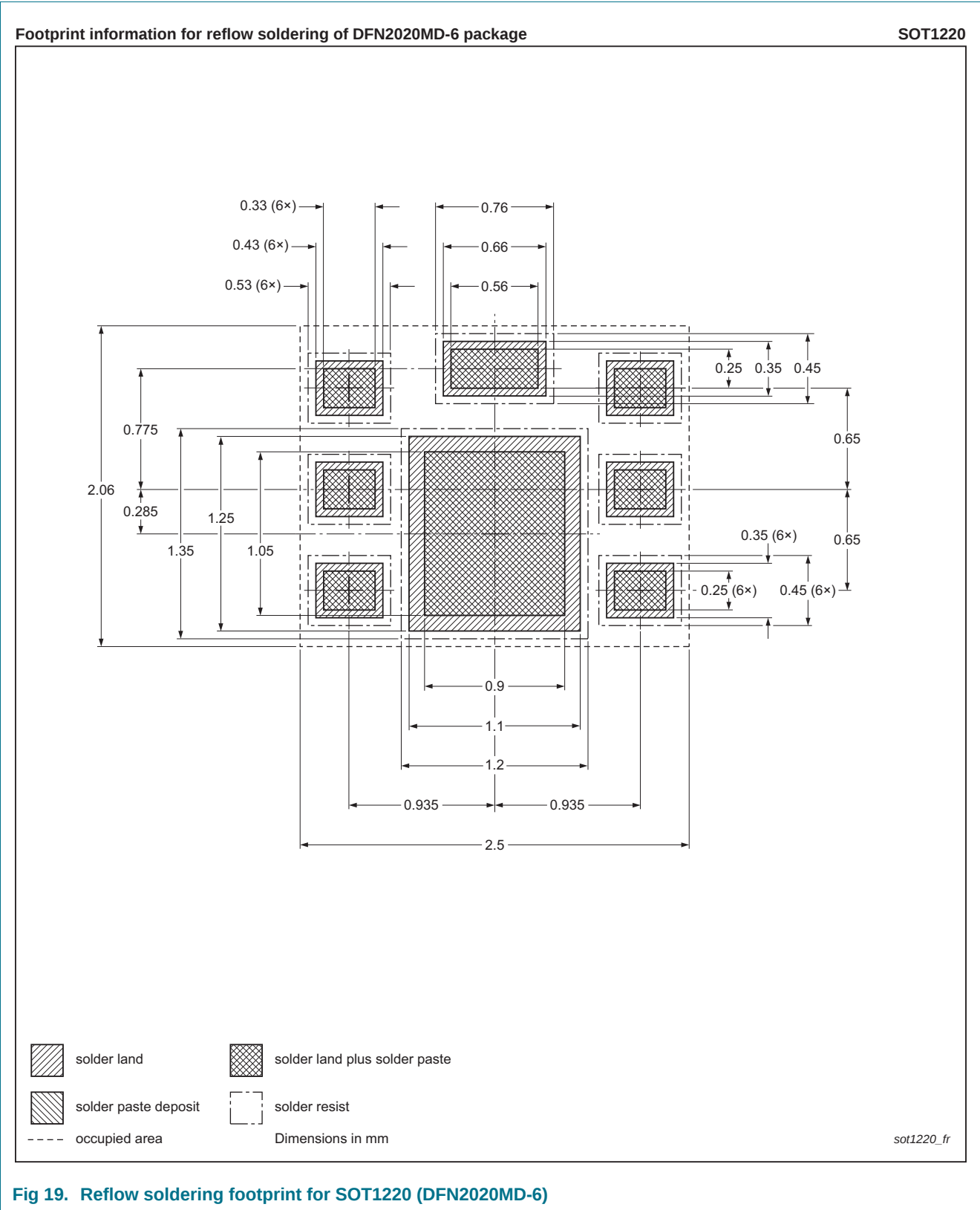


Fig 19. Reflow soldering footprint for SOT1220 (DFN2020MD-6)

## 11. Revision history

Table 8. Revision history

| Document ID  | Release date | Data sheet status  | Change notice | Supersedes |
|--------------|--------------|--------------------|---------------|------------|
| PMPB20EN v.1 | 20120516     | Product data sheet | -             | -          |

## 12. Legal information

### 12.1 Data sheet status

| Document status <sup>[1] [2]</sup> | Product status <sup>[3]</sup> | 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.                                     |

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## 14. Contents

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|           |                                          |           |
|-----------|------------------------------------------|-----------|
| <b>1</b>  | <b>Product profile</b> . . . . .         | <b>1</b>  |
| 1.1       | General description . . . . .            | 1         |
| 1.2       | Features and benefits . . . . .          | 1         |
| 1.3       | Applications . . . . .                   | 1         |
| 1.4       | Quick reference data . . . . .           | 1         |
| <b>2</b>  | <b>Pinning information</b> . . . . .     | <b>2</b>  |
| <b>3</b>  | <b>Ordering information</b> . . . . .    | <b>2</b>  |
| <b>4</b>  | <b>Marking</b> . . . . .                 | <b>2</b>  |
| <b>5</b>  | <b>Limiting values</b> . . . . .         | <b>3</b>  |
| <b>6</b>  | <b>Thermal characteristics</b> . . . . . | <b>4</b>  |
| <b>7</b>  | <b>Characteristics</b> . . . . .         | <b>6</b>  |
| <b>8</b>  | <b>Test information</b> . . . . .        | <b>10</b> |
| <b>9</b>  | <b>Package outline</b> . . . . .         | <b>10</b> |
| <b>10</b> | <b>Soldering</b> . . . . .               | <b>11</b> |
| <b>11</b> | <b>Revision history</b> . . . . .        | <b>12</b> |
| <b>12</b> | <b>Legal information</b> . . . . .       | <b>13</b> |
| 12.1      | Data sheet status . . . . .              | 13        |
| 12.2      | Definitions . . . . .                    | 13        |
| 12.3      | Disclaimers . . . . .                    | 13        |
| 12.4      | Trademarks . . . . .                     | 14        |
| <b>13</b> | <b>Contact information</b> . . . . .     | <b>14</b> |

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