



PMPB12UNEA

20 V, N-channel Trench MOSFET

26 March 2018

Product data sheet

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.

2. Features and benefits

- Low threshold voltage
- Trench MOSFET technology
- Side wettable flanks for optical solder inspection
- ElectroStatic Discharge (ESD) protection > 500 V HBM (class H1B)
- AEC-Q101 qualified

3. Applications

- Relay driver
- High-speed line driver
- Low-side load switch
- Switching circuits

4. Quick reference data

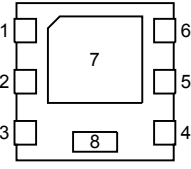
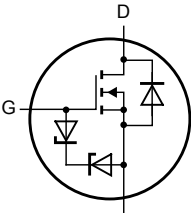
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|---|-----|-----|-----|------|
| V_{DS} | drain-source voltage | $T_j = 25\text{ °C}$ | - | - | 20 | V |
| V_{GS} | gate-source voltage | | -12 | - | 12 | V |
| I_D | drain current | $V_{GS} = 4.5\text{ V}; T_{amb} = 25\text{ °C}$ | [1] | - | 7.9 | A |
| Static characteristics | | | | | | |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 4.5\text{ V}; I_D = 7.9\text{ A}; T_j = 25\text{ °C}$ | - | 13 | 18 | mΩ |

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

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-------------|--|--|
| 1 | D | drain |  <p>Transparent top view DFN2020MD-6 (SOT1220)</p> |  <p>017aaa255</p> |
| 2 | D | drain | | |
| 3 | G | gate | | |
| 4 | S | source | | |
| 5 | D | drain | | |
| 6 | D | drain | | |
| 7 | D | drain | | |
| 8 | S | source | | |

6. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|-------------|-------------|---|---------|
| | Name | Description | Version |
| PMPB12UNEA | DFN2020MD-6 | DFN2020MD-6: plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals | SOT1220 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PMPB12UNEA | 4F |

8. Limiting values

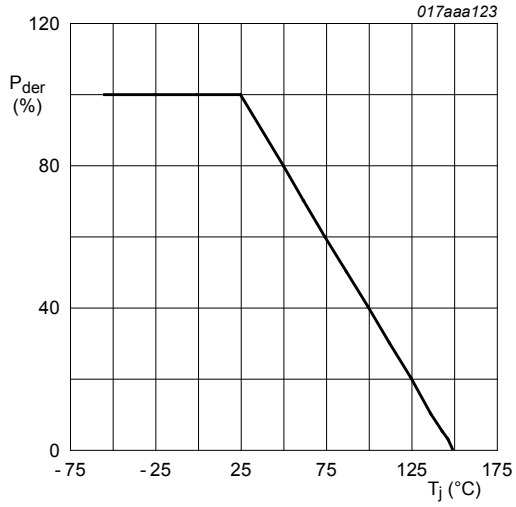
Table 5. Limiting values

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|-----------------------------|--|---|-----|-----|------|------|
| V_{DS} | drain-source voltage | $T_j = 25\text{ °C}$ | | - | 20 | V |
| V_{GS} | gate-source voltage | | | -12 | 12 | V |
| I_D | drain current | $V_{GS} = 4.5\text{ V}; T_{amb} = 25\text{ °C}$ | [1] | - | 7.9 | A |
| | | $V_{GS} = 4.5\text{ V}; T_{amb} = 100\text{ °C}$ | [1] | - | 5 | A |
| I_{DM} | peak drain current | $T_{amb} = 25\text{ °C}$; single pulse; $t_p \leq 10\text{ }\mu\text{s}$ | | - | 32 | A |
| P_{tot} | total power dissipation | $T_{amb} = 25\text{ °C}$ | [1] | - | 1.6 | W |
| | | $T_{sp} = 25\text{ °C}$ | | - | 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 | $T_{amb} = 25\text{ °C}$ | [1] | - | 1.5 | A |
| ESD maximum rating | | | | | | |
| V_{ESD} | electrostatic discharge voltage | HBM | [2] | - | 500 | V |
| Avalanche ruggedness | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $T_{j(\text{init})} = 25\text{ °C}$; $I_D = 1.3\text{ A}$; DUT in avalanche (unclamped) | | - | 13.7 | mJ |

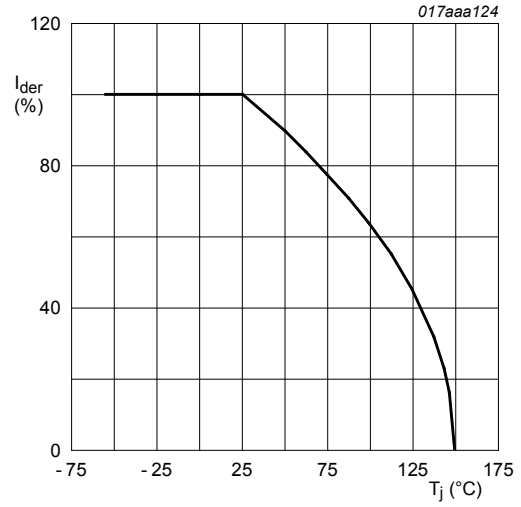
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm^2 .

[2] Measured between all pins.



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

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



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

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

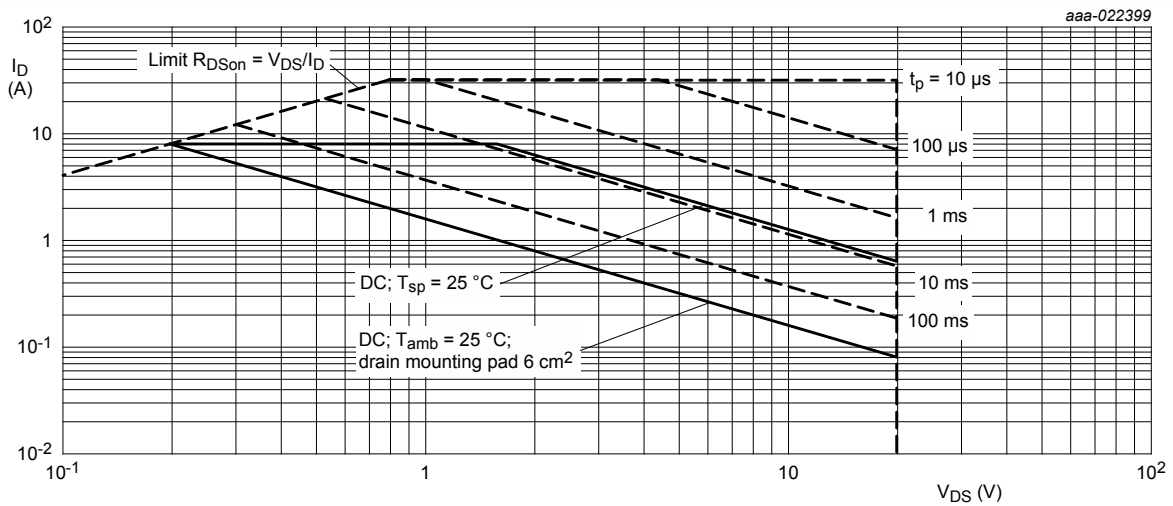


Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

9. 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] | - | 230 | 265 | K/W |
| | | | [2] | - | 70 | 80 | 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 cm².

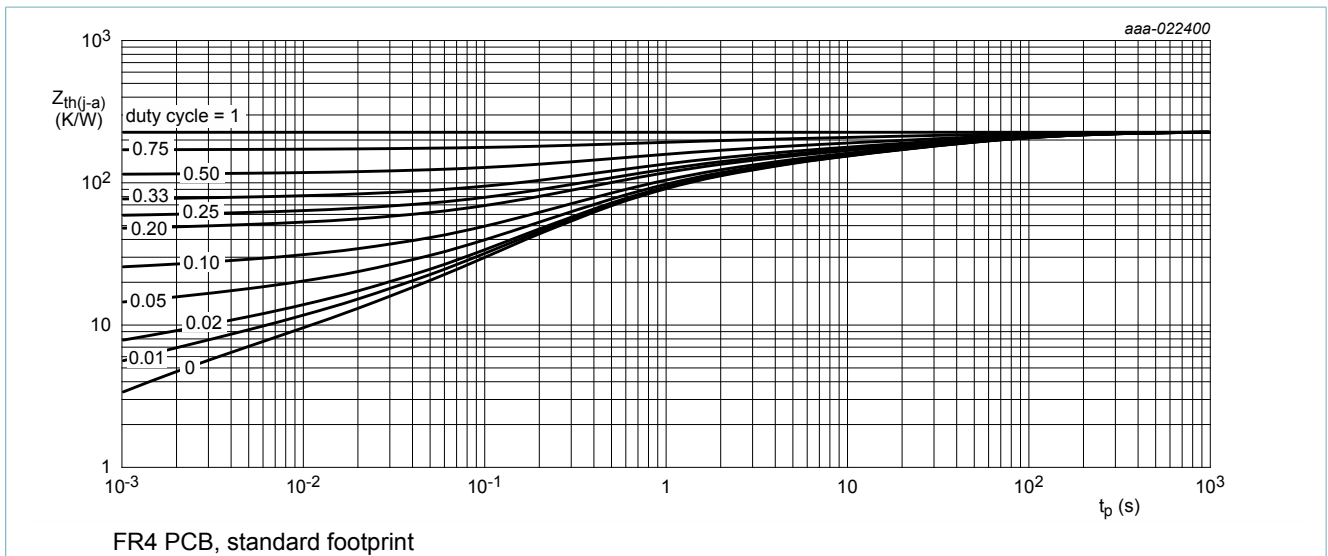


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

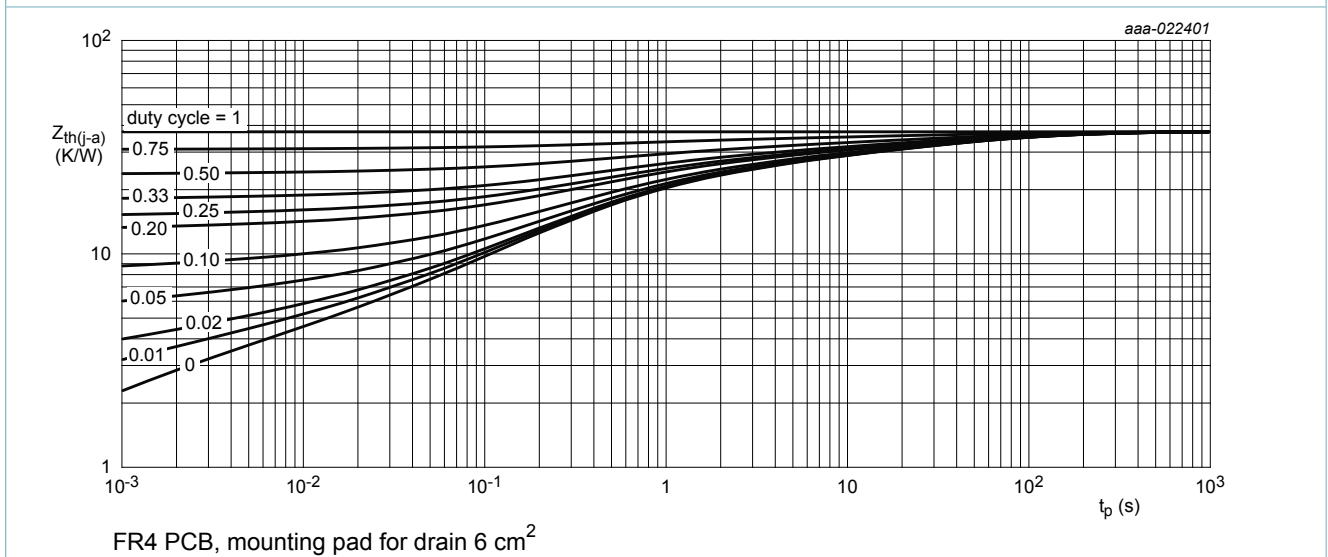


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|------|------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | 20 | - | - | V |
| V_{GSth} | gate-source threshold voltage | $I_D = 250 \mu A$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ }^\circ C$ | 0.4 | 0.65 | 0.9 | V |
| I_{DSS} | drain leakage current | $V_{DS} = 20 V$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 1 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 8 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 10 | μA |
| | | $V_{GS} = -8 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | -10 | μA |
| | | $V_{GS} = 4.5 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 1 | μA |
| | | $V_{GS} = -4.5 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | -1 | μA |
| | | $V_{GS} = 2.5 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 100 | nA |
| | | $V_{GS} = -2.5 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | -100 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 4.5 V$; $I_D = 7.9 A$; $T_j = 25 \text{ }^\circ C$ | - | 13 | 18 | m Ω |
| | | $V_{GS} = 4.5 V$; $I_D = 7.9 A$; $T_j = 150 \text{ }^\circ C$ | - | 21 | 28 | m Ω |
| | | $V_{GS} = 2.5 V$; $I_D = 7.1 A$; $T_j = 25 \text{ }^\circ C$ | - | 16 | 22 | m Ω |
| | | $V_{GS} = 1.8 V$; $I_D = 1.9 A$; $T_j = 25 \text{ }^\circ C$ | - | 21 | 30 | m Ω |
| g_{fs} | forward transconductance | $V_{DS} = 10 V$; $I_D = 7.9 A$; $T_j = 25 \text{ }^\circ C$ | - | 18 | - | S |
| R_G | gate resistance | $f = 1 \text{ MHz}$ | - | 1.8 | - | Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS} = 10 V$; $I_D = 6 A$; $V_{GS} = 4.5 V$; $T_j = 25 \text{ }^\circ C$ | - | 10.9 | 17 | nC |
| Q_{GS} | gate-source charge | | - | 1.3 | - | nC |
| Q_{GD} | gate-drain charge | | - | 2.1 | - | nC |
| C_{iss} | input capacitance | $V_{DS} = 10 V$; $f = 1 \text{ MHz}$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | 1220 | - | pF |
| C_{oss} | output capacitance | | - | 124 | - | pF |
| C_{rss} | reverse transfer capacitance | | - | 102 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 10 V$; $I_D = 6 A$; $V_{GS} = 4.5 V$; $R_{G(ext)} = 6 \Omega$; $T_j = 25 \text{ }^\circ C$ | - | 10 | - | ns |
| t_r | rise time | | - | 24 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 32 | - | ns |
| t_f | fall time | | - | 34 | - | ns |
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 1.5 A$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | 0.7 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 1.5 A$; $di_S/dt = -100 \text{ A}/\mu s$; $V_{GS} = 0 V$; $V_{DS} = 10 V$; $T_j = 25 \text{ }^\circ C$ | - | 10 | - | ns |
| Q_r | recovered charge | | - | 2 | - | nC |

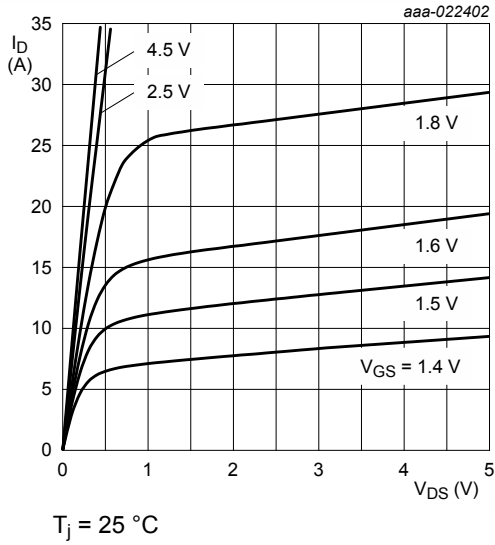


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

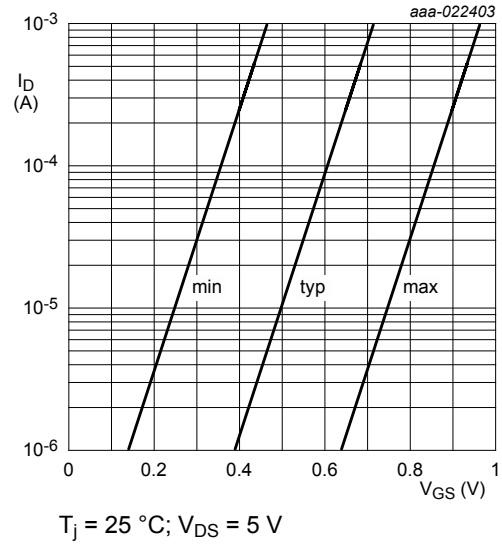


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

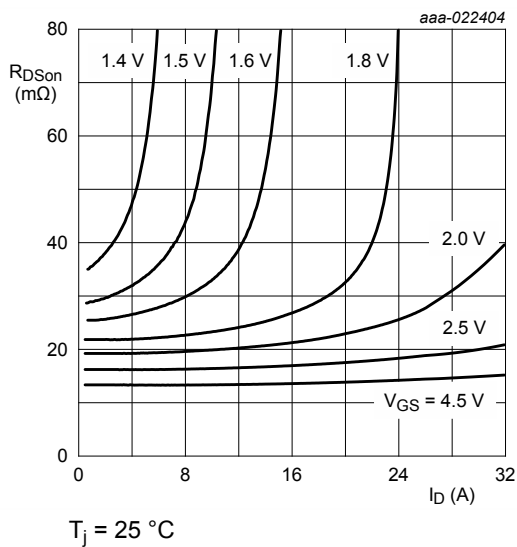


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

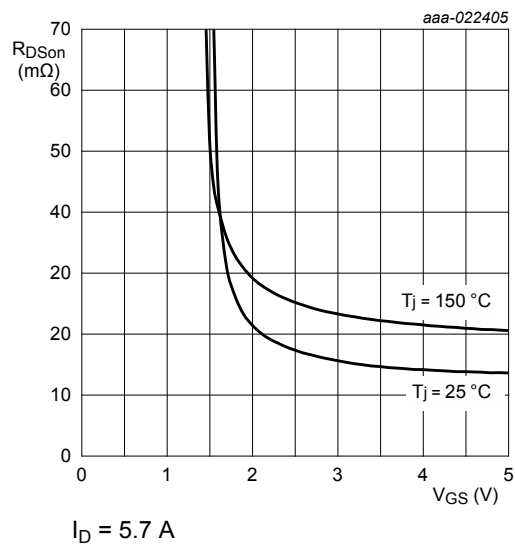
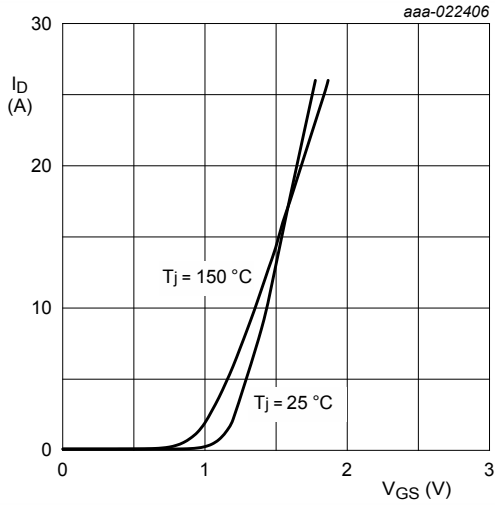
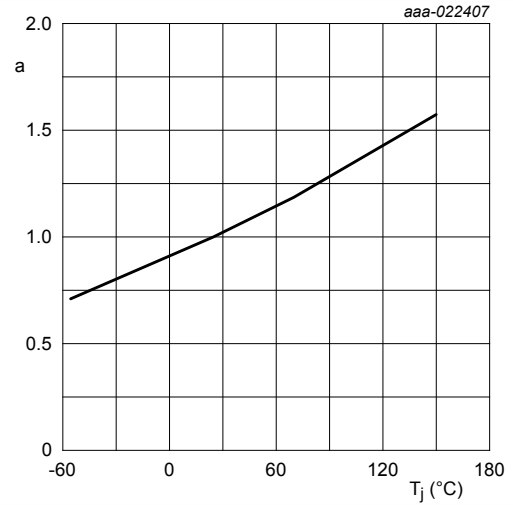


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



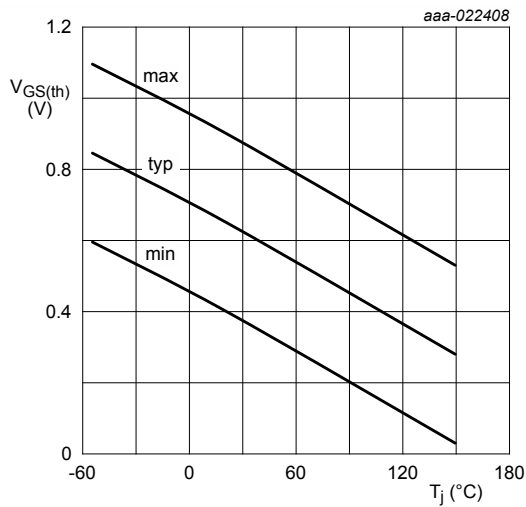
$$V_{DS} > I_D \times R_{DSon}$$

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



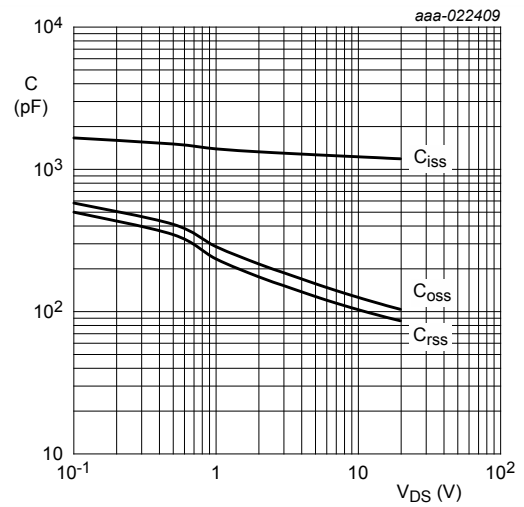
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

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



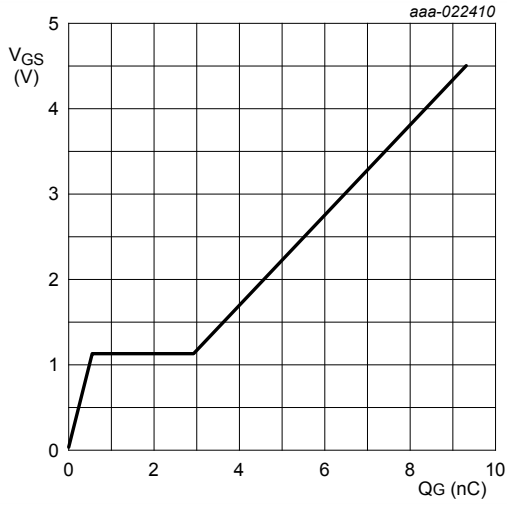
$$I_D = 0.25 \text{ mA}; V_{DS} = V_{GS}$$

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



$I_D = 6\text{ A}$; $V_{DS} = 10\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$

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

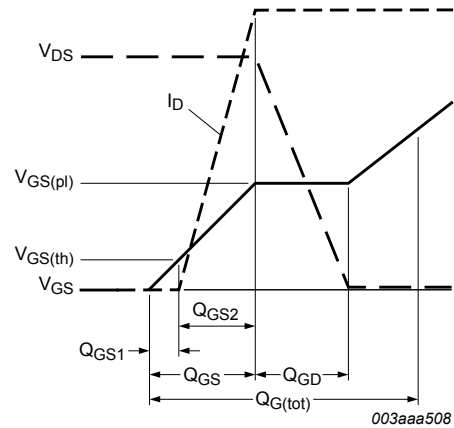
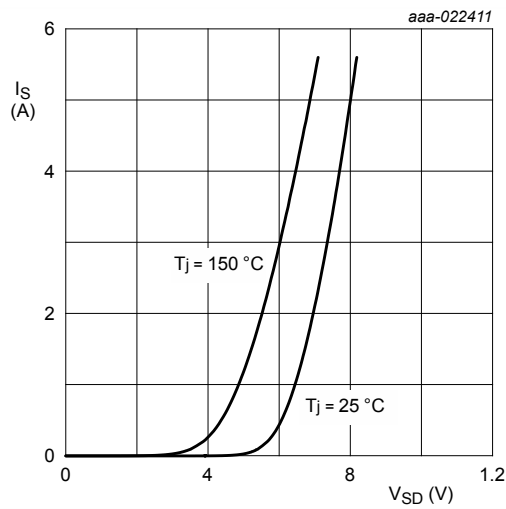


Fig. 15. Gate charge waveform definitions



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

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

11. Test information

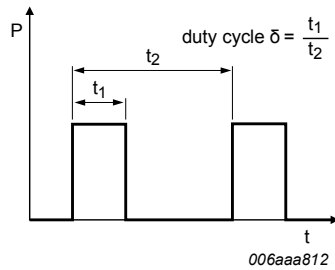


Fig. 17. Duty cycle definition

Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - Stress test qualification for discrete semiconductors, and is suitable for use in automotive applications.

12. Package outline

DFN2020MD-6: plastic thermal enhanced ultra thin small outline package; no leads;
6 terminals; body 2 x 2 x 0.65 mm

SOT1220

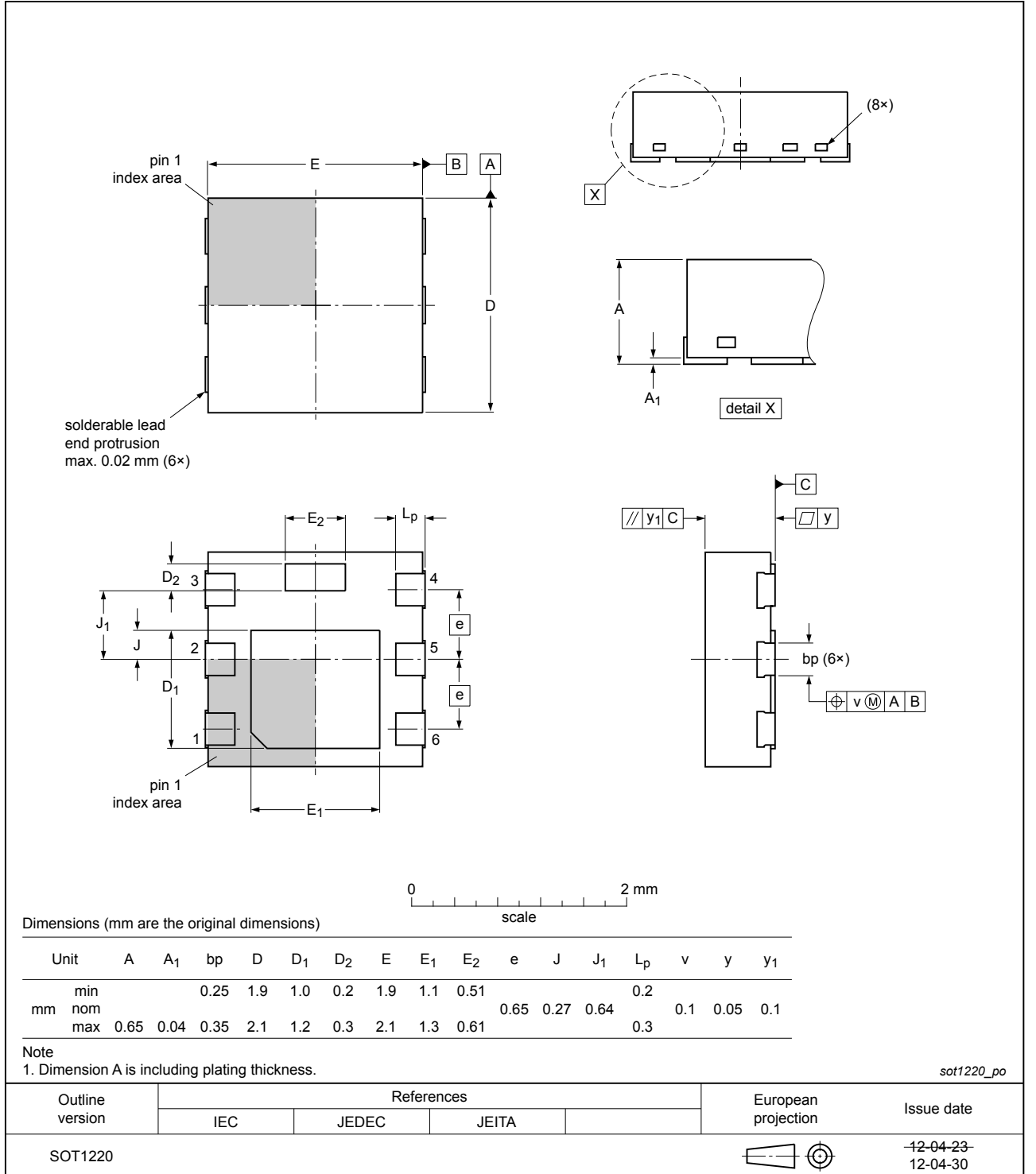


Fig. 18. Package outline DFN2020MD-6 (SOT1220)

13. Soldering

Footprint information for reflow soldering of DFN2020MD-6 package

SOT1220

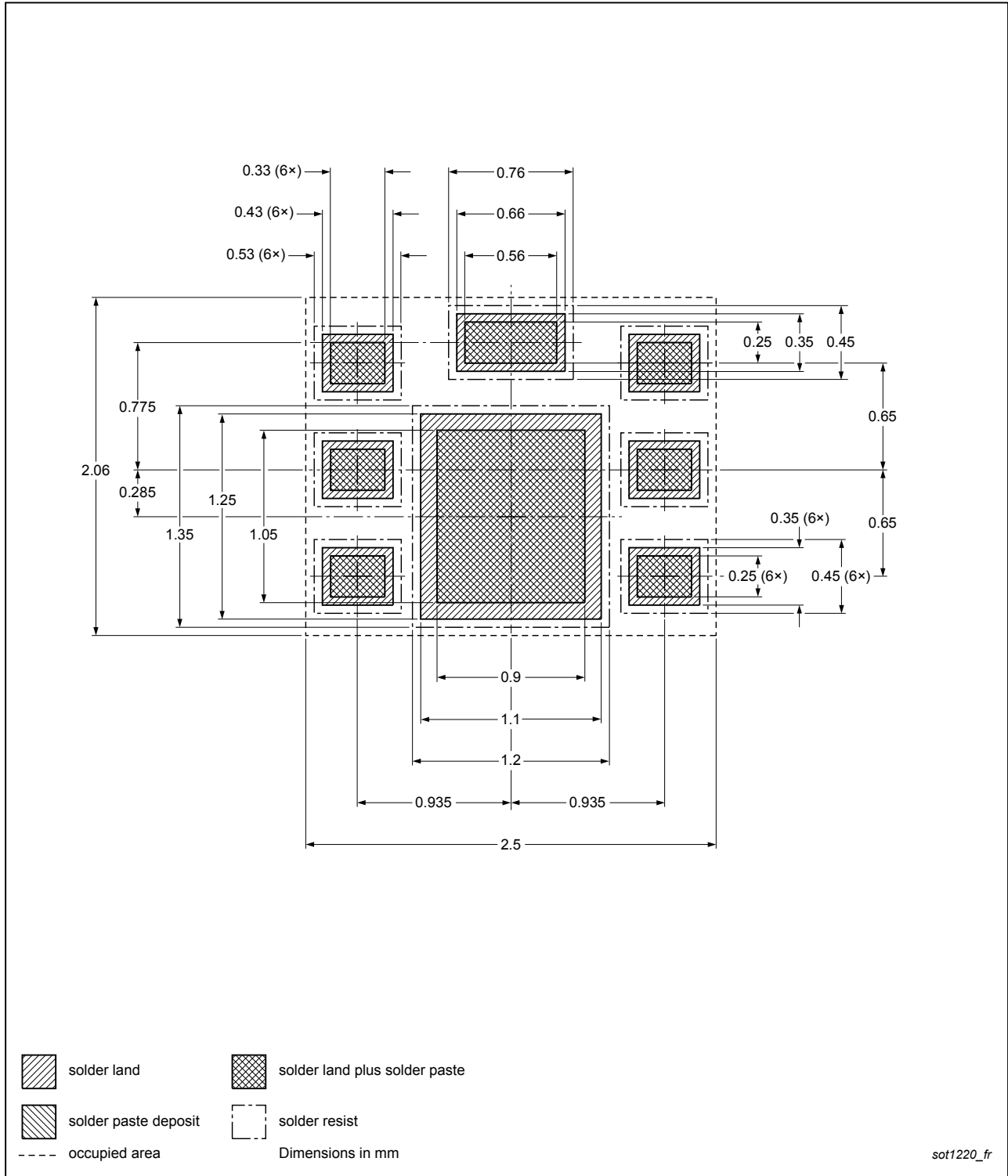


Fig. 19. Reflow soldering footprint for DFN2020MD-6 (SOT1220)

14. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--------------|--------------------|---------------|------------|
| PMPB12UNEA v.1 | 20180326 | Product data sheet | - | - |

15. Legal information

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. |

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