



# 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

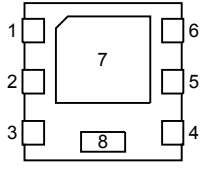
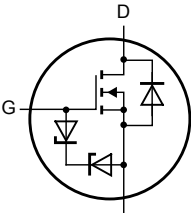
Table 1. Quick reference data

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
<b>Static characteristics</b>						
$R_{DSon}$	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 cm<sup>2</sup>.

## 5. Pinning information

Table 2. Pinning information

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

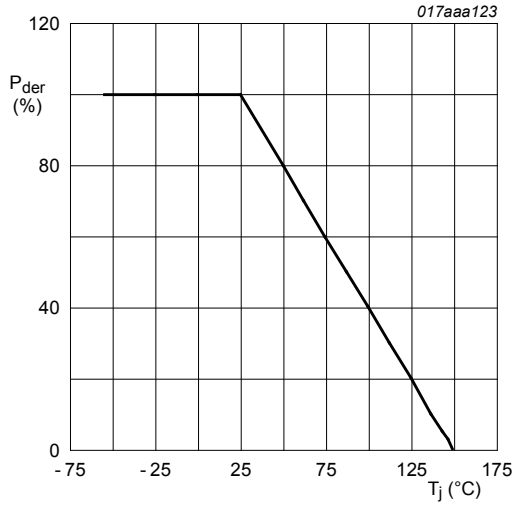
**Table 5. Limiting values**

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
<b>Source-drain diode</b>						
$I_S$	source current	$T_{amb} = 25\text{ °C}$	[1]	-	1.5	A
<b>ESD maximum rating</b>						
$V_{ESD}$	electrostatic discharge voltage	HBM	[2]	-	500	V
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	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

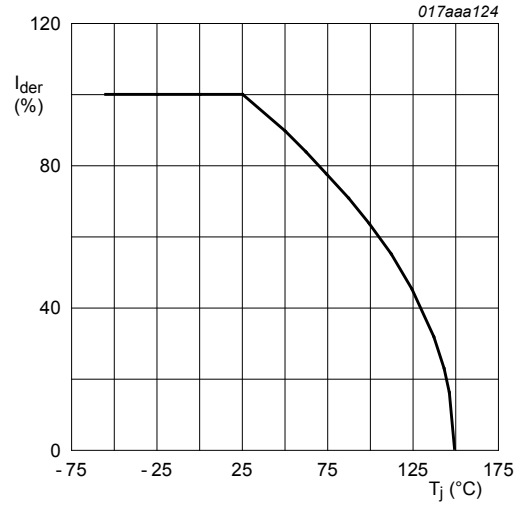
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain  $6\text{ cm}^2$ .

[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

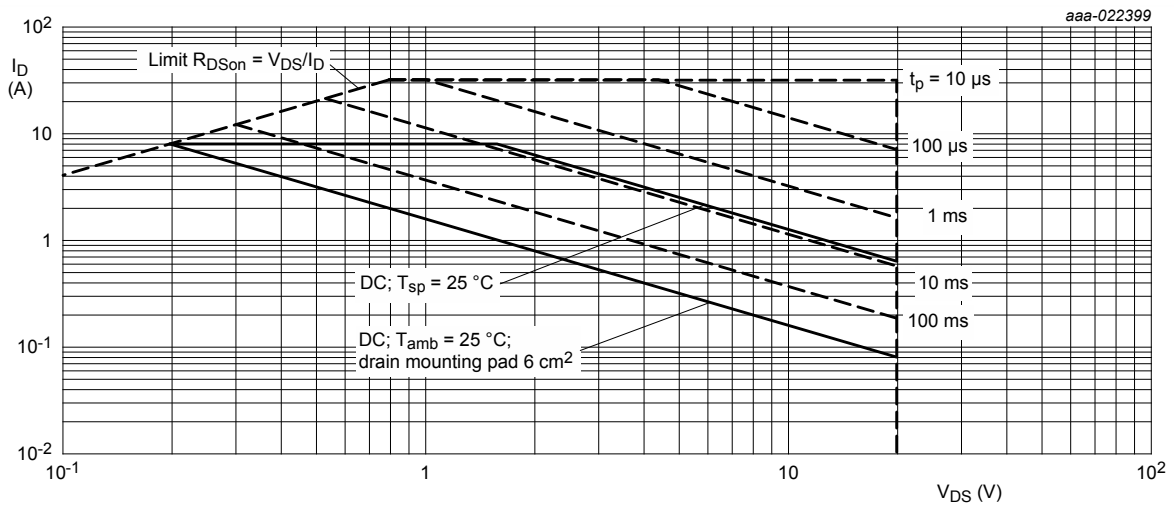


Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

### 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air	[1]	-	230	265	K/W
			[2]	-	70	80	K/W
R <sub>th(j-sp)</sub>	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<sup>2</sup>.

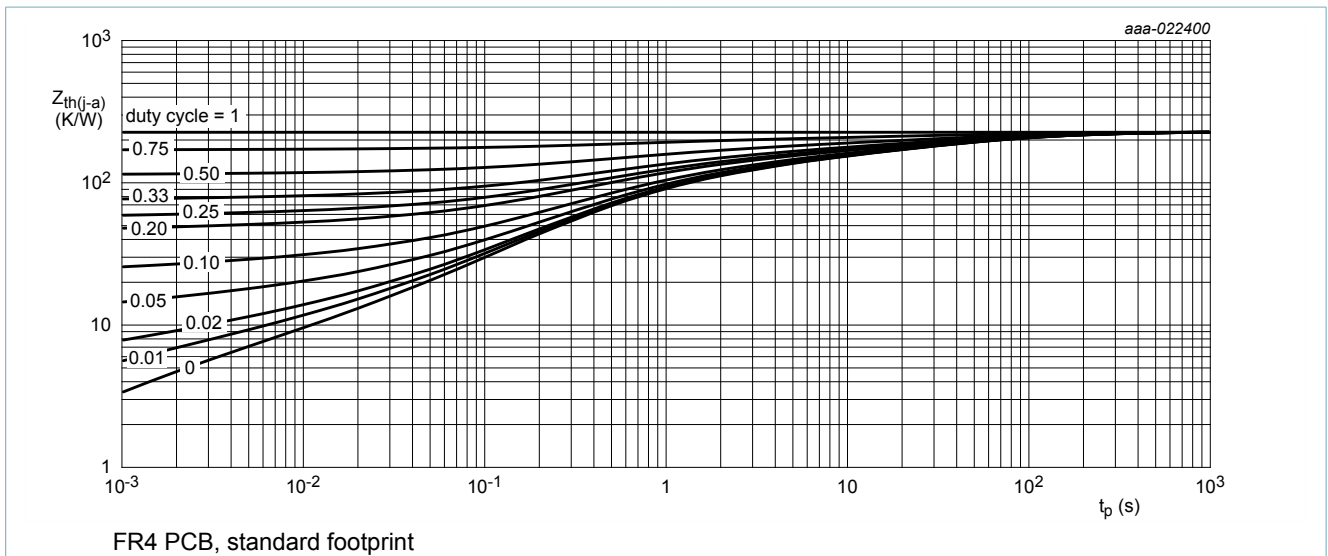


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

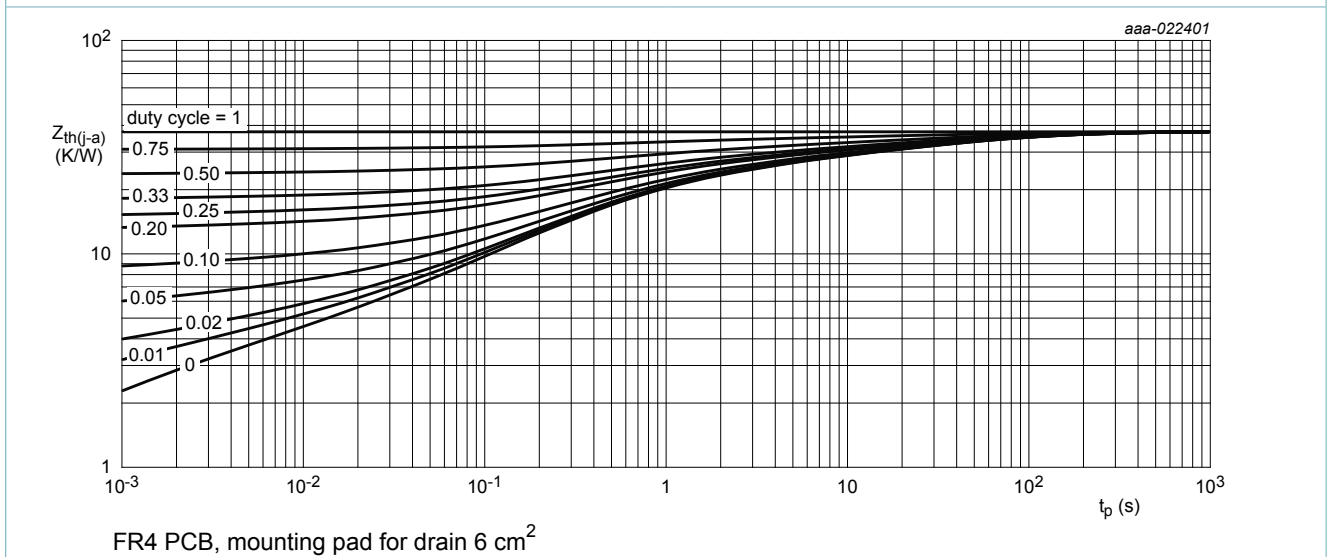
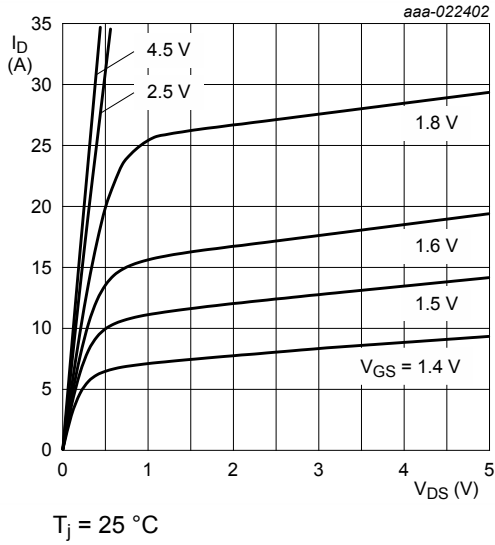


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

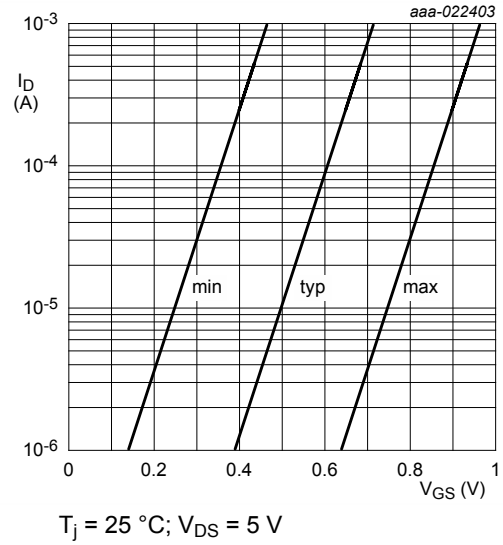
## 10. Characteristics

Table 7. Characteristics

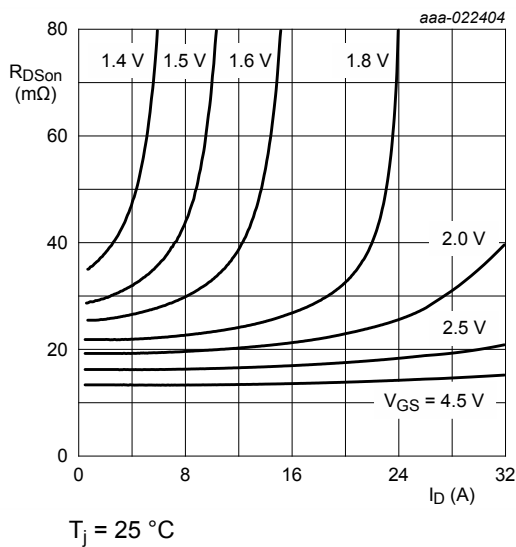
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	20	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ C$	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	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 8 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	10	$\mu A$
		$V_{GS} = -8 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	-10	$\mu A$
		$V_{GS} = 4.5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	1	$\mu A$
		$V_{GS} = -4.5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	-1	$\mu A$
		$V_{GS} = 2.5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	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 $\Omega$
		$V_{GS} = 4.5 V$ ; $I_D = 7.9 A$ ; $T_j = 150 \text{ }^\circ C$	-	21	28	m $\Omega$
		$V_{GS} = 2.5 V$ ; $I_D = 7.1 A$ ; $T_j = 25 \text{ }^\circ C$	-	16	22	m $\Omega$
		$V_{GS} = 1.8 V$ ; $I_D = 1.9 A$ ; $T_j = 25 \text{ }^\circ C$	-	21	30	m $\Omega$
$g_{fs}$	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	-	$\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	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	$V_{DS} = 10 V$ ; $I_D = 6 A$ ; $V_{GS} = 4.5 V$ ; $R_{G(ext)} = 6 \text{ } \Omega$ ; $T_j = 25 \text{ }^\circ C$	-	10	-	ns
$t_r$	rise time		-	24	-	ns
$t_{d(off)}$	turn-off delay time		-	32	-	ns
$t_f$	fall time		-	34	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	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



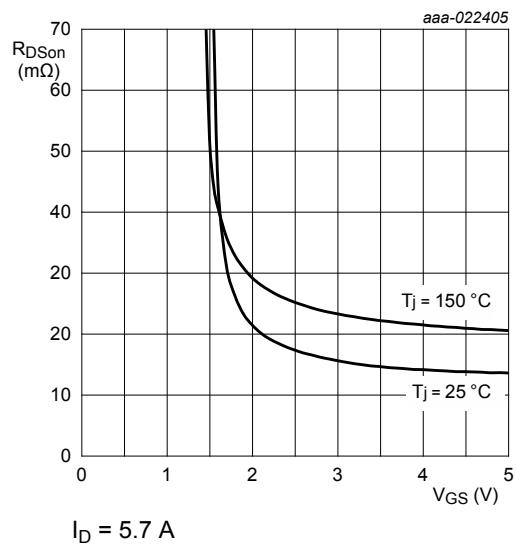
**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



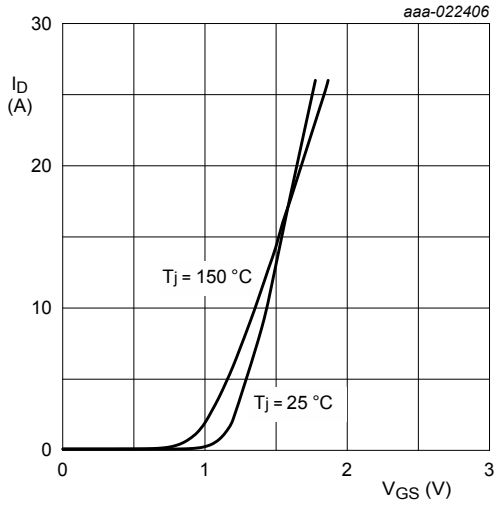
**Fig. 7. Sub-threshold drain current as a function of gate-source voltage**



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

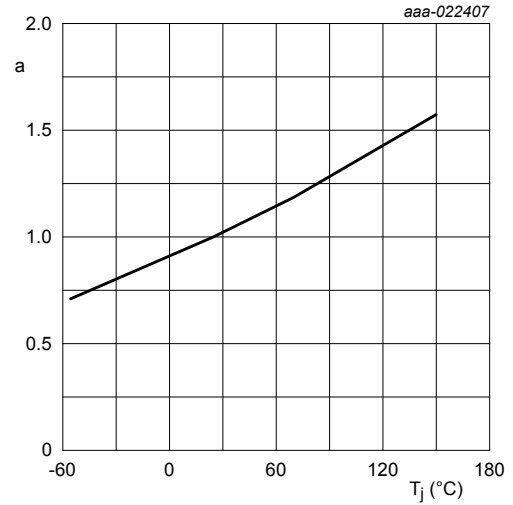


**Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values**



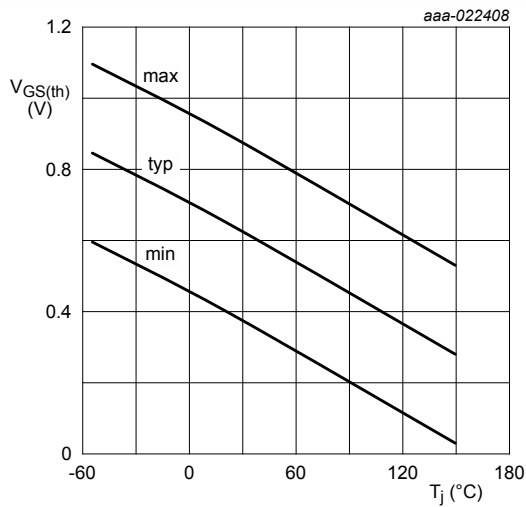
$$V_{DS} > I_D \times R_{DSon}$$

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



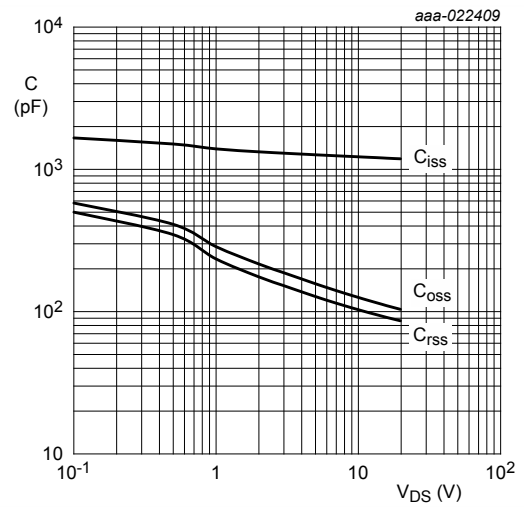
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

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



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

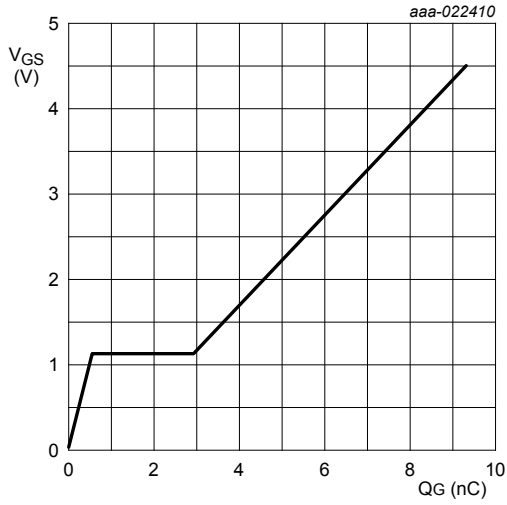
**Fig. 12. Gate-source threshold voltage as a function of junction temperature**



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

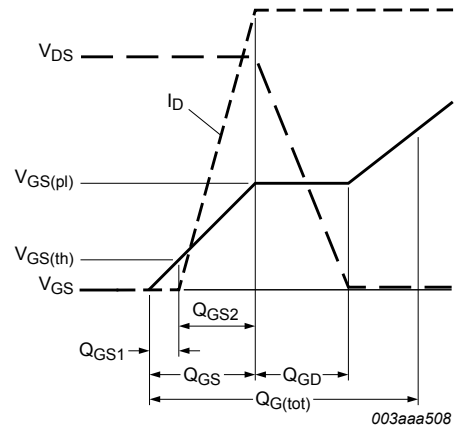
**Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



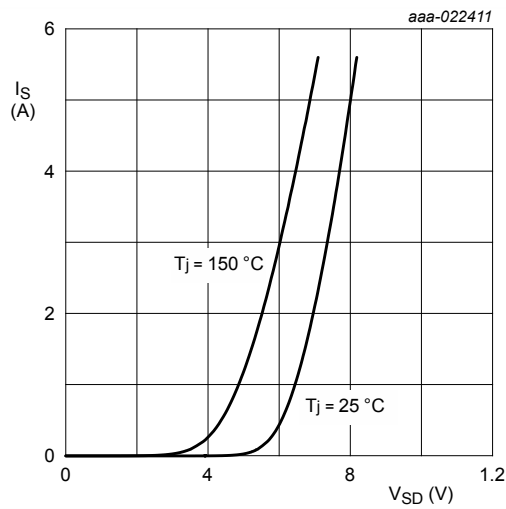


$I_D = 6 \text{ A}$ ;  $V_{DS} = 10 \text{ V}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$

**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

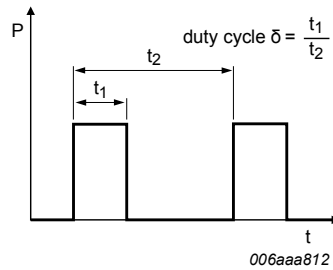


Fig. 17. Duty cycle definition

### 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

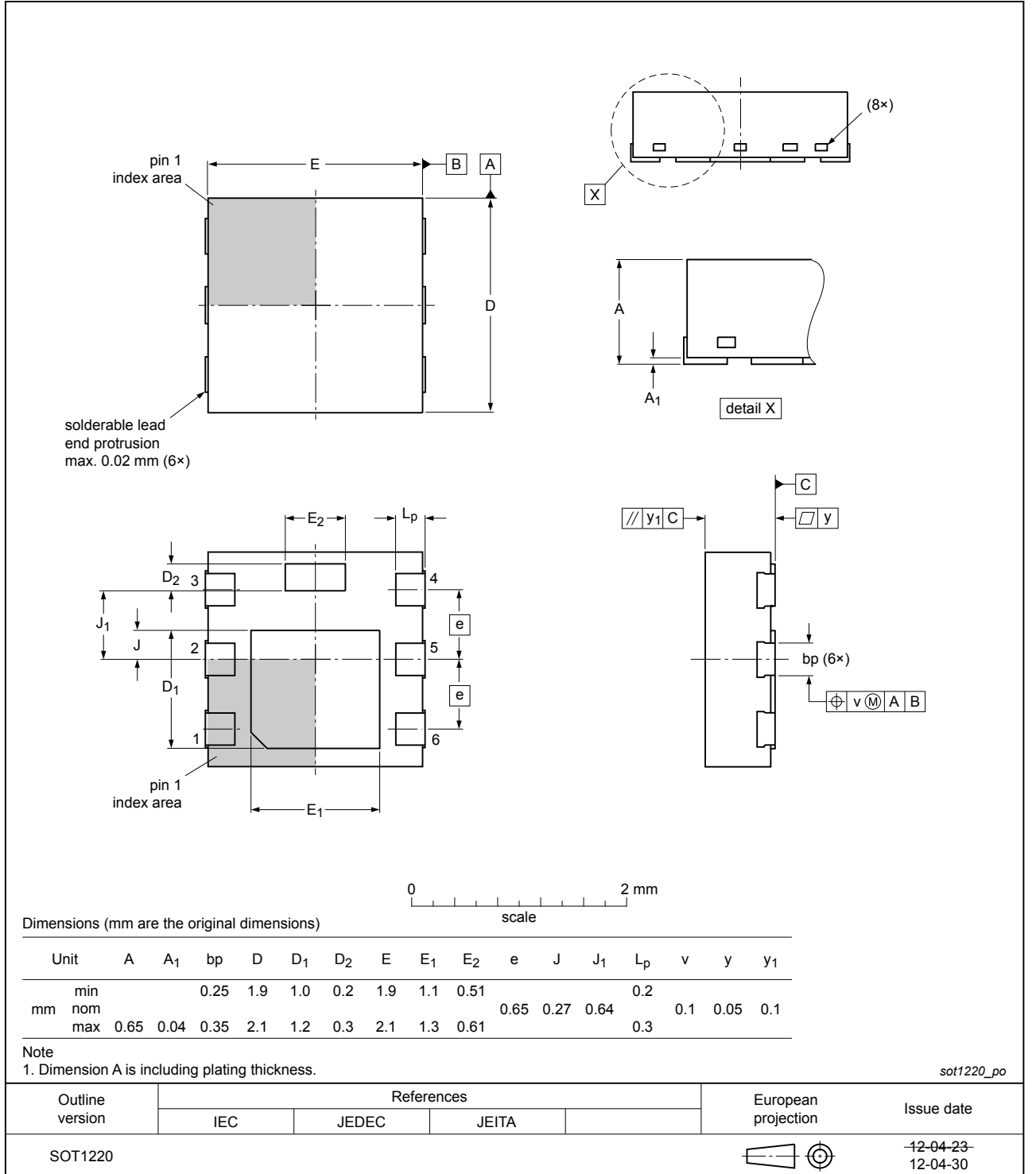


Fig. 18. Package outline DFN2020MD-6 (SOT1220)

### 13. Soldering

Footprint information for reflow soldering of DFN2020MD-6 package

SOT1220

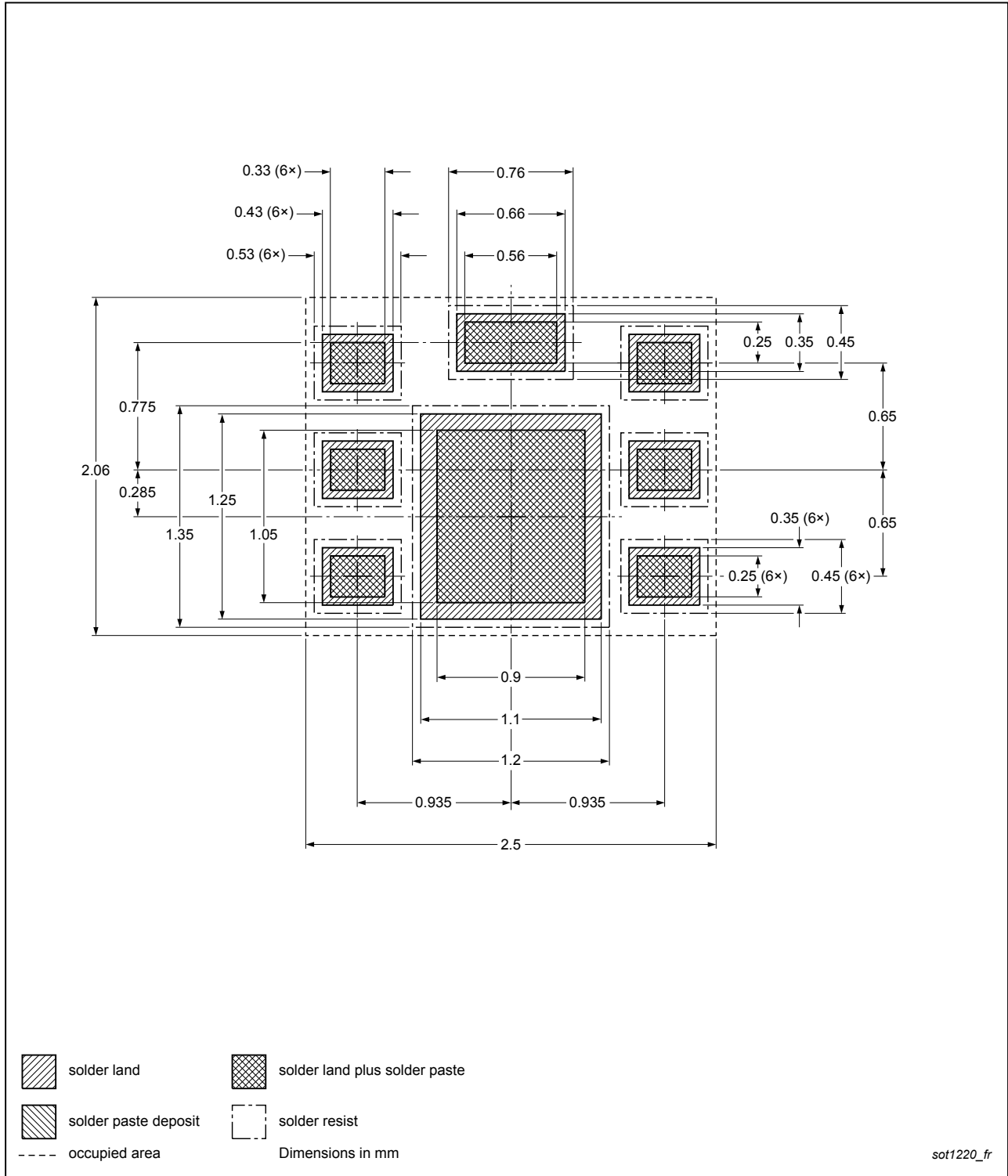


Fig. 19. Reflow soldering footprint for DFN2020MD-6 (SOT1220)

## 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.

- [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".
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