



# PMPB15XPA

12 V, P-channel Trench MOSFET

27 March 2018

Product data sheet

## 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.

## 2. Features and benefits

- Low threshold voltage
- Trench MOSFET technology
- Side wettable flanks for optical solder inspection
- Small and leadless ultra thin SMD plastic package: 2 x 2 x 0.65 mm
- AEC-Q101 qualified

## 3. Applications

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

## 4. Quick reference data

Table 1. Quick reference data

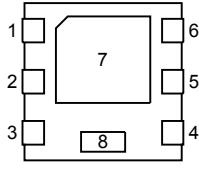
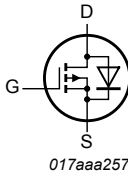
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	-12	V
$V_{GS}$	gate-source voltage		-12	-	12	V
$I_D$	drain current	$V_{GS} = -4.5\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	-8.2	A
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = -4.5\text{ V}; I_D = -8.2\text{ A}; T_j = 25\text{ °C}$	-	15	20	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>.

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## 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>017aaa257</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
PMPB15XPA	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
PMPB15XPA	4J

## 8. Limiting values

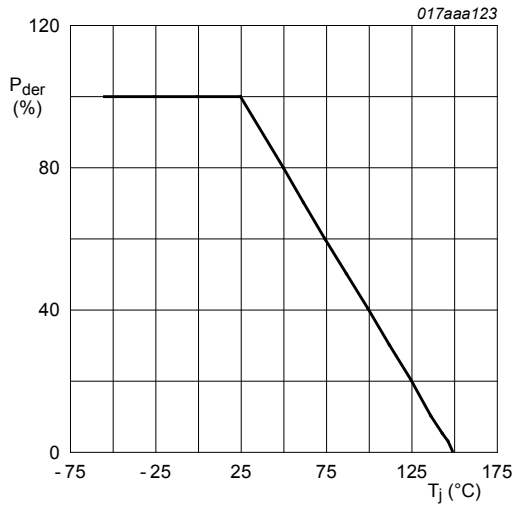
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$		-	-12	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]	-	-8.2	A
		$V_{GS} = -4.5\text{ V}; T_{amb} = 100\text{ °C}$	[1]	-	-5.2	A
$I_{DM}$	peak drain current	$T_{amb} = 25\text{ °C}$ ; single pulse; $t_p \leq 10\text{ }\mu\text{s}$		-	-33	A
$P_{tot}$	total power dissipation	$T_{amb} = 25\text{ °C}$	[1]	-	1.7	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]	-	-1.9	A
<b>ESD maximum rating</b>						
$V_{ESD}$	electrostatic discharge voltage	HBM	[2]	-	1000	V
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = -3.8\text{ A}$ ; DUT in avalanche (unclamped)		-	23.9	mJ

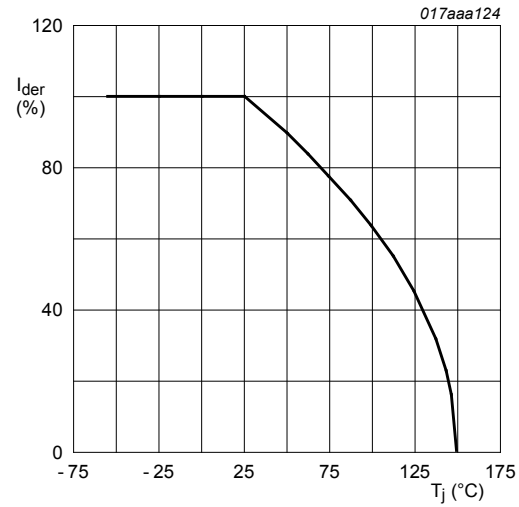
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain  $6\text{ cm}^2$ .

[2] Measured between all pins.



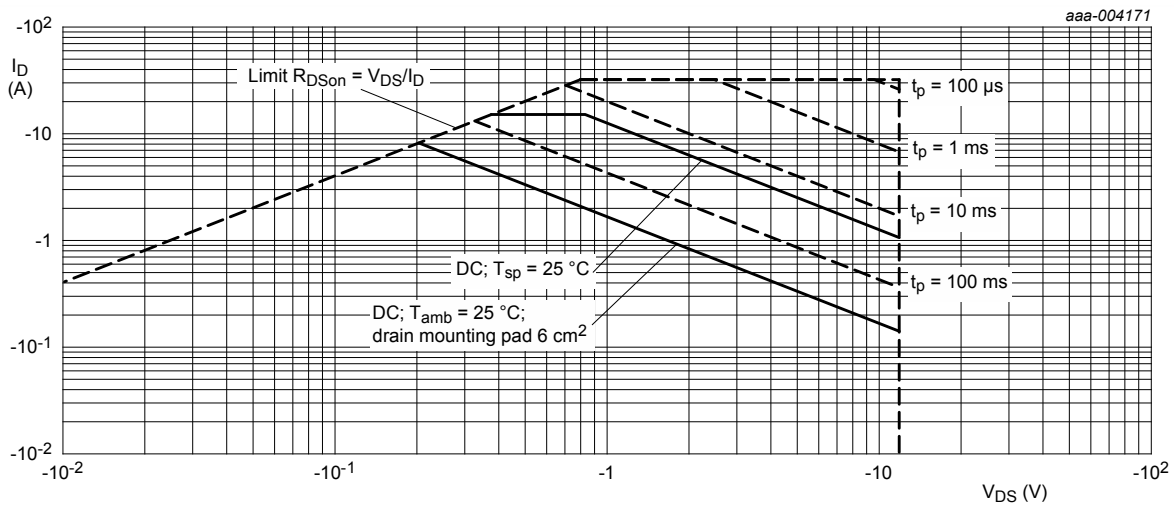
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100 \%$$

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



$I_{DM}$  = single pulse

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]	-	235	270	K/W
			[2]	-	67	74	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<sup>2</sup>.

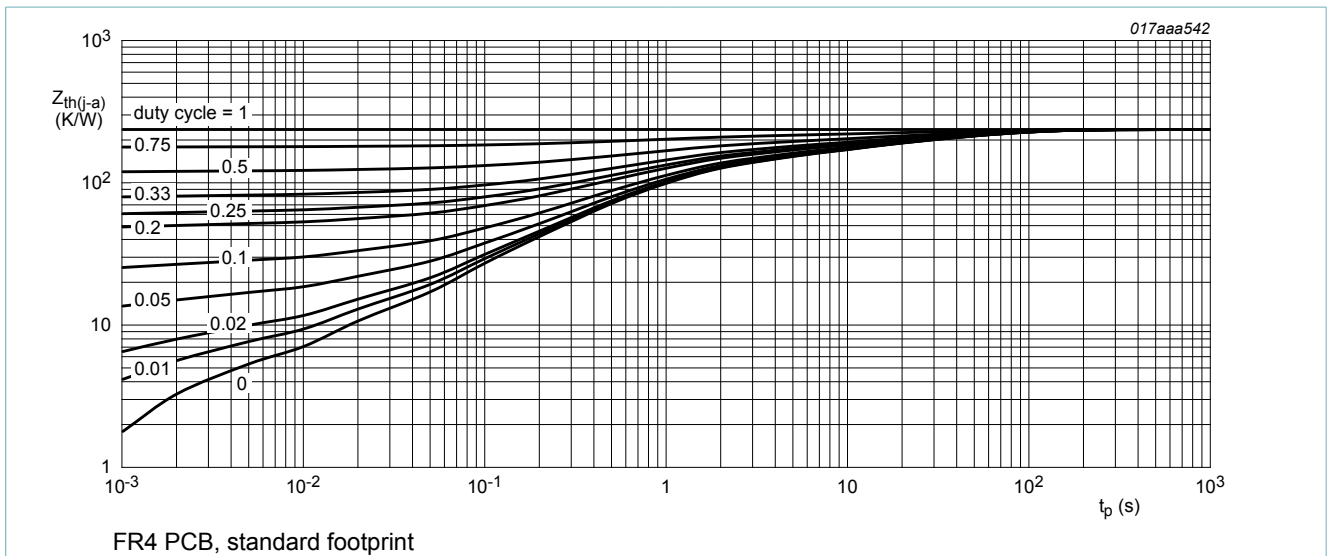


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

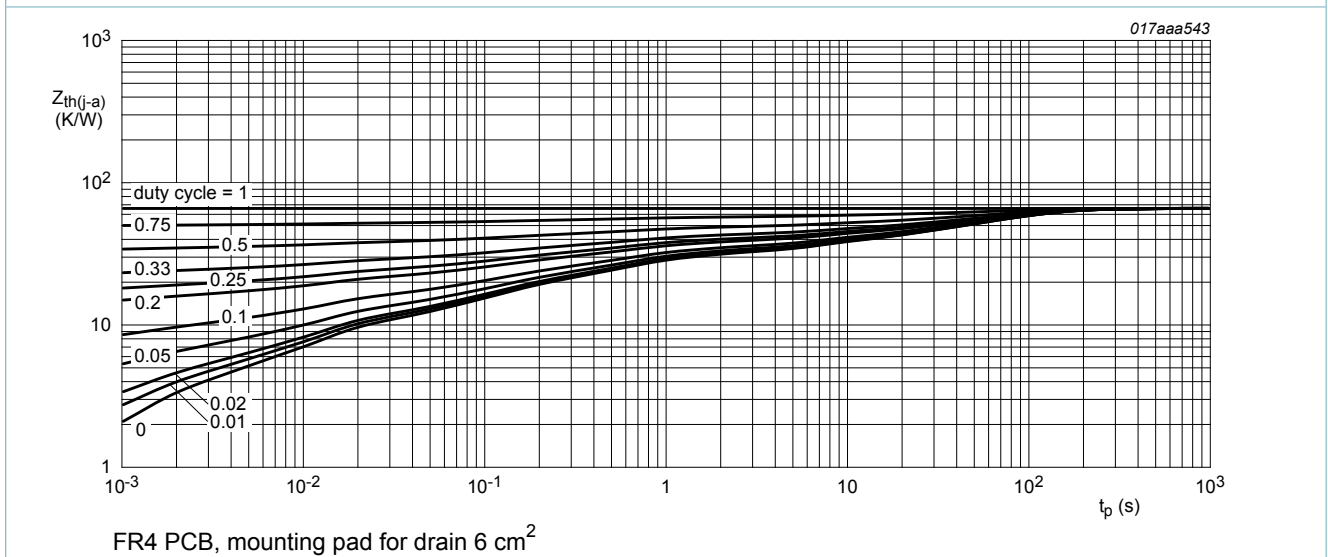
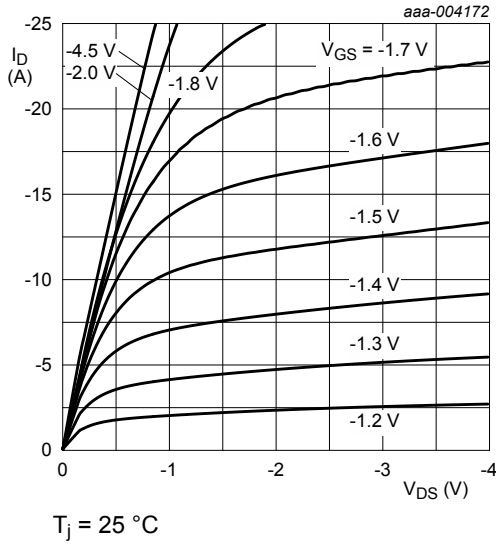


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

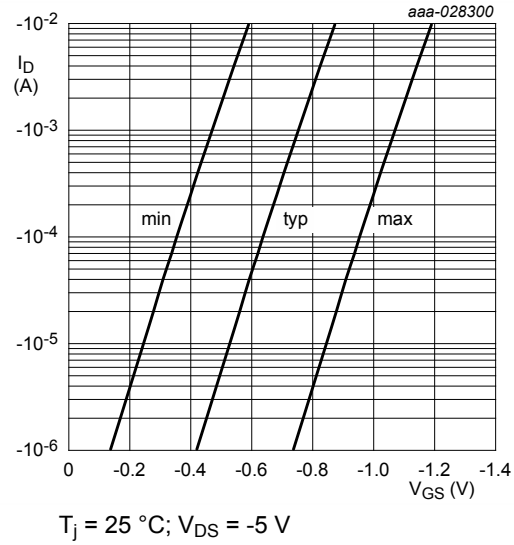
## 10. Characteristics

Table 7. Characteristics

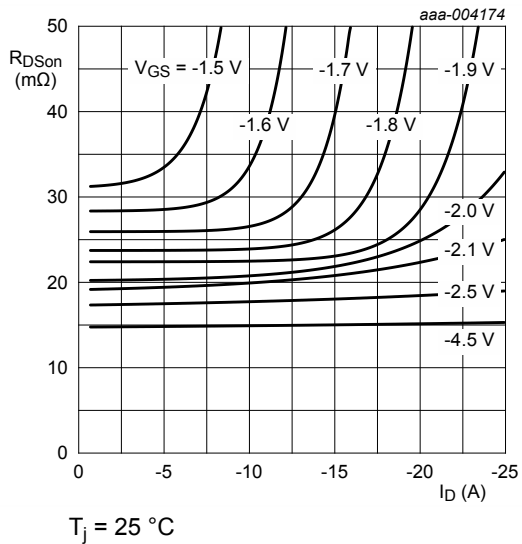
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = -250 \mu\text{A}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-12	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = -250 \mu\text{A}$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-0.4	-0.7	-1	V
$I_{DSS}$	drain leakage current	$V_{DS} = -12 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-1	$\mu\text{A}$
		$V_{DS} = -12 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 150 \text{ }^\circ\text{C}$	-	-	-100	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = -12 \text{ V}$ ; $V_{DS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-100	nA
		$V_{GS} = 12 \text{ V}$ ; $V_{DS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-100	nA
$R_{DSon}$	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	20	m $\Omega$
		$V_{GS} = -4.5 \text{ V}$ ; $I_D = -8.2 \text{ A}$ ; $T_j = 150 \text{ }^\circ\text{C}$	-	20	25	m $\Omega$
		$V_{GS} = -2.5 \text{ V}$ ; $I_D = -3.9 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	17	23	m $\Omega$
		$V_{GS} = -1.8 \text{ V}$ ; $I_D = -3.9 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	21	38	m $\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = -10 \text{ V}$ ; $I_D = -8.2 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	40	-	S
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = -6 \text{ V}$ ; $I_D = -8.2 \text{ A}$ ; $V_{GS} = -4.5 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	67	100	nC
$Q_{GS}$	gate-source charge		-	5.5	-	nC
$Q_{GD}$	gate-drain charge		-	7.3	-	nC
$C_{iss}$	input capacitance	$V_{DS} = -6 \text{ V}$ ; $f = 1 \text{ MHz}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	2875	-	pF
$C_{oss}$	output capacitance		-	570	-	pF
$C_{rss}$	reverse transfer capacitance		-	530	-	pF
$t_{d(on)}$	turn-on delay time		$V_{DS} = -6 \text{ V}$ ; $I_D = -8.2 \text{ A}$ ; $V_{GS} = -4.5 \text{ V}$ ; $R_{G(ext)} = 6 \text{ } \Omega$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	18	-
$t_r$	rise time	-		90	-	ns
$t_{d(off)}$	turn-off delay time	-		85	-	ns
$t_f$	fall time	-		57	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = -1.9 \text{ A}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-0.6	-1.2	V
$t_{rr}$	reverse recovery time	$I_S = -1.9 \text{ A}$ ; $dI_S/dt = 100 \text{ A}/\mu\text{s}$ ; $V_{GS} = 0 \text{ V}$ ; $V_{DS} = -10 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	42	-	ns
$Q_r$	recovered charge		-	35	-	nC



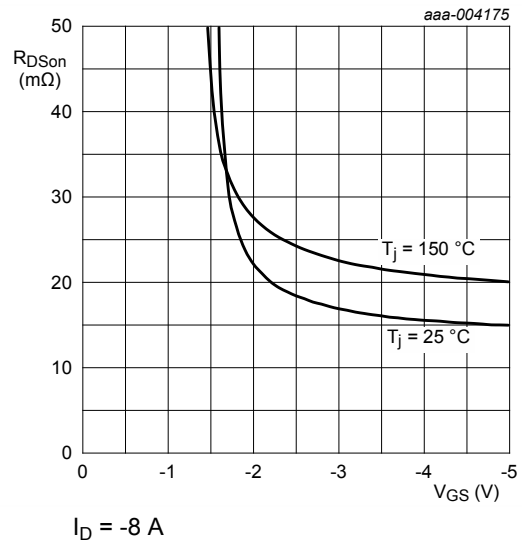
**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



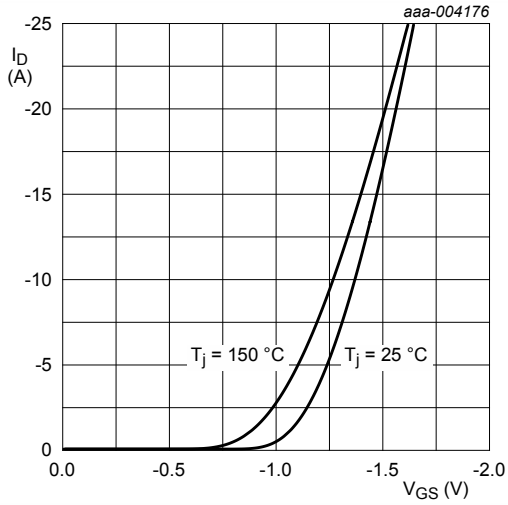
**Fig. 7. Sub-threshold drain current as a function of gate-source voltage**



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

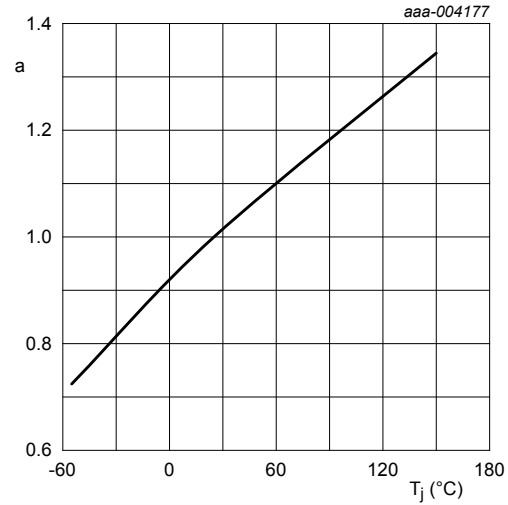


**Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values**



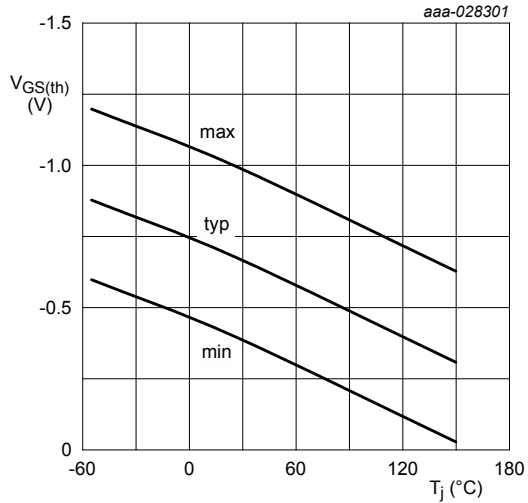
$$V_{DS} > I_D \times R_{DSon}$$

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



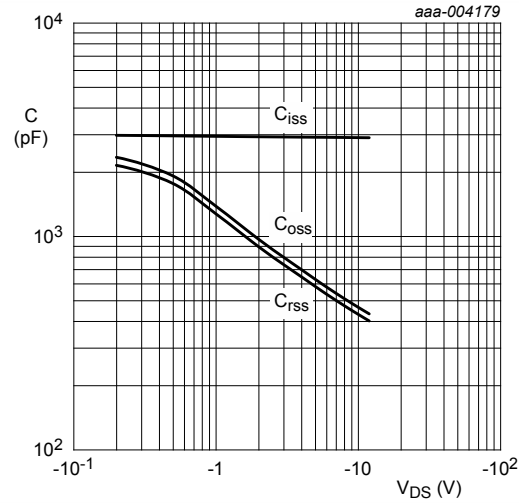
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

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



$$I_D = -250 \mu A; V_{DS} = V_{GS}$$

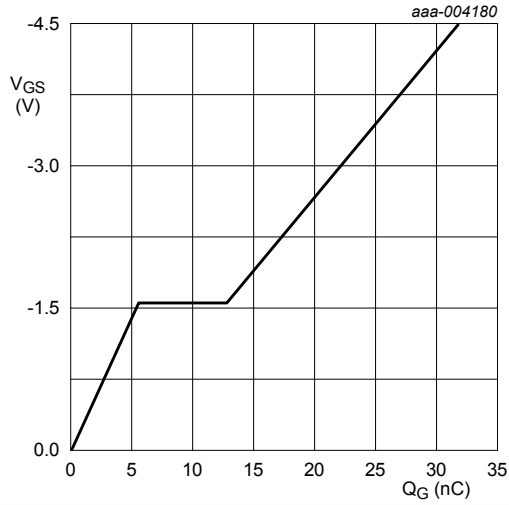
**Fig. 12. Gate-source threshold voltage as a function of junction temperature**



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

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





$I_D = -8$  A;  $V_{DS} = -6$  V;  $T_{amb} = 25$  °C

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

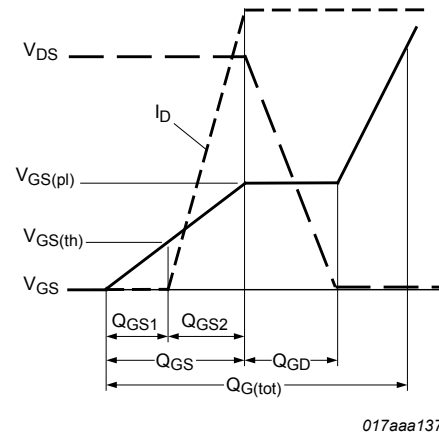
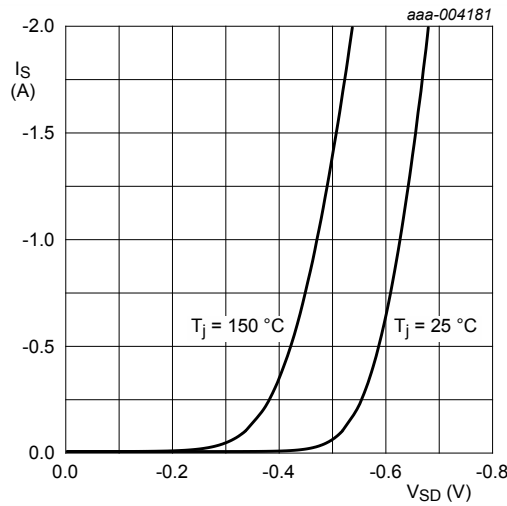


Fig. 15. Gate charge waveform definitions



$V_{GS} = 0$  V

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

### 11. Test information

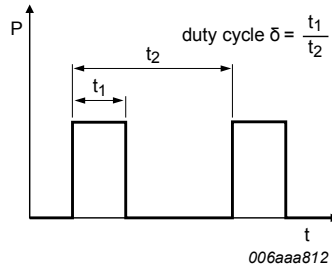


Fig. 17. Duty cycle definition

#### 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

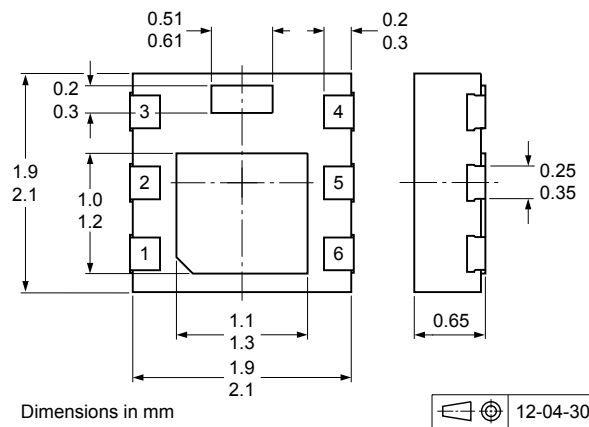


Fig. 18. Package outline DFN2020MD-6 (SOT1220)

### 13. Soldering

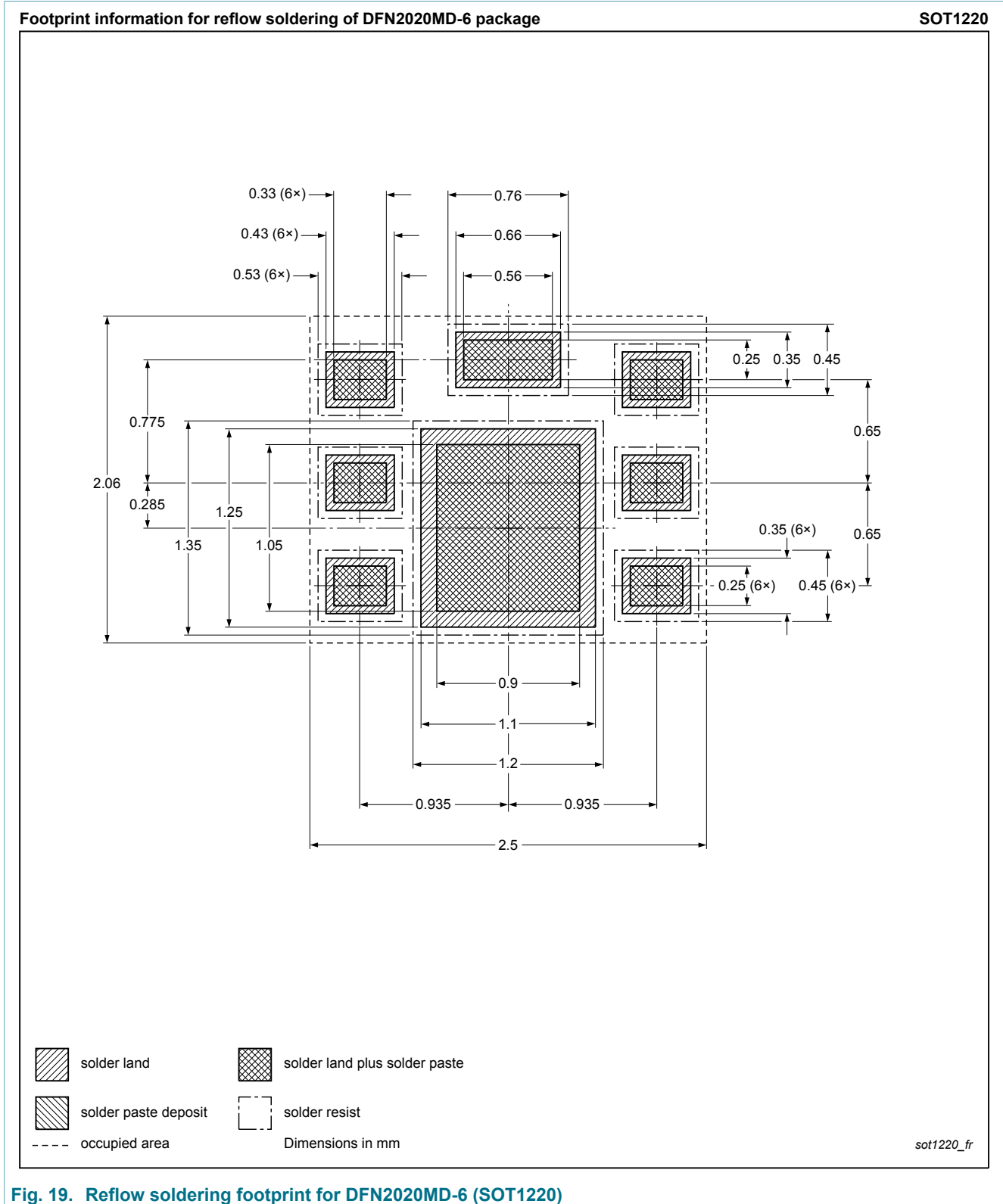


Fig. 19. Reflow soldering footprint for DFN2020MD-6 (SOT1220)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMPB15XPA v.1	20180327	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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Date of release: 27 March 2018

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