



# PMCPB5530X

20 V, complementary Trench MOSFET

Rev. 1 — 26 June 2012

Product data sheet

## 1. Product profile

### 1.1 General description

Complementary N/P-channel enhancement mode Field-Effect Transistor (FET) in a small and leadless ultra thin DFN2020-6 (SOT1118) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

### 1.2 Features and benefits

- Very fast switching
- 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

### 1.3 Applications

- Charging switch for portable devices
- DC-to-DC converters
- Small brushless DC motor drive
- Power management in battery-driven portables
- Hard disc and computing power management

### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR1 (N-channel), Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}; I_D = 3\text{ A}; T_j = 25\text{ °C}$	-	26	34	mΩ
<b>TR2 (P-channel), Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = -4.5\text{ V}; I_D = -3.4\text{ A}; T_j = 25\text{ °C}$	-	55	70	mΩ
<b>TR1 (N-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	20	V
$V_{GS}$	gate-source voltage		-12	-	12	V
$I_D$	drain current	$V_{GS} = 4.5\text{ V}; T_{amb} = 25\text{ °C}; t \leq 5\text{ s}$	<a href="#">1</a>	-	5.3	A

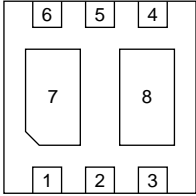
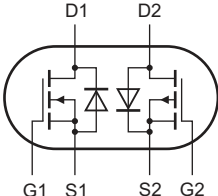
Table 1. Quick reference data ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR2 (P-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	-20	V
$V_{GS}$	gate-source voltage		-12	-	12	V
$I_D$	drain current	$V_{GS} = -4.5\text{ V}$ ; $T_{amb} = 25\text{ °C}$ ; $t \leq 5\text{ s}$	[1]	-	-4.5	A

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

## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source TR1	 <p>Transparent top view</p> <p><b>DFN2020-6 (SOT1118)</b></p>	 <p>017aaa261</p>
2	G1	gate TR1		
3	D2	drain TR2		
4	S2	source TR2		
5	G2	gate TR2		
6	D1	drain TR1		
7	D1	drain TR1		
8	D2	drain TR2		

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMCPB5530X	DFN2020-6	plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals	SOT1118

## 4. Marking

Table 4. Marking codes

Type number	Marking code
PMCPB5530X	1W

## 5. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
<b>TR1 (N-channel)</b>					
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	20	V
$V_{GS}$	gate-source voltage		-12	12	V

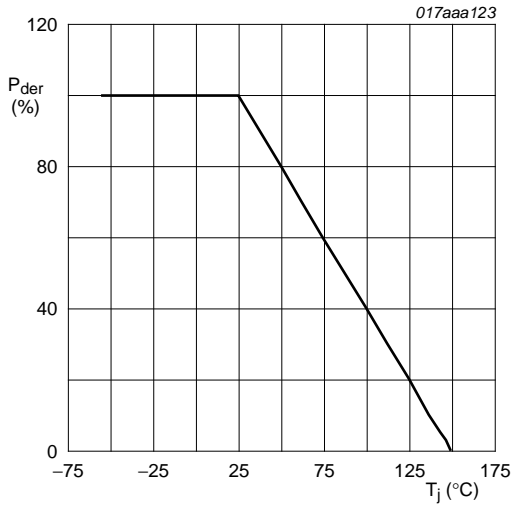
**Table 5. Limiting values ...continued**

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

Symbol	Parameter	Conditions		Min	Max	Unit
I <sub>D</sub>	drain current	V <sub>GS</sub> = 4.5 V; T <sub>amb</sub> = 25 °C; t ≤ 5 s	[1]	-	5.3	A
		V <sub>GS</sub> = 4.5 V; T <sub>amb</sub> = 25 °C	[1]	-	4	A
		V <sub>GS</sub> = 4.5 V; T <sub>amb</sub> = 100 °C	[1]	-	2.6	A
I <sub>DM</sub>	peak drain current	T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs		-	12	A
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = 25 °C	[2]	-	490	mW
			[1]	-	1170	mW
		T <sub>sp</sub> = 25 °C		-	8330	mW
<b>TR1 (N-channel), Source-drain diode</b>						
I <sub>S</sub>	source current	T <sub>amb</sub> = 25 °C	[1]	-	1.2	A
<b>TR2 (P-channel)</b>						
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> = 25 °C		-	-20	V
V <sub>GS</sub>	gate-source voltage			-12	12	V
I <sub>D</sub>	drain current	V <sub>GS</sub> = -4.5 V; T <sub>amb</sub> = 25 °C; t ≤ 5 s	[1]	-	-4.5	A
		V <sub>GS</sub> = -4.5 V; T <sub>amb</sub> = 25 °C	[1]	-	-3.4	A
		V <sub>GS</sub> = -4.5 V; T <sub>amb</sub> = 100 °C	[1]	-	-2.2	A
I <sub>DM</sub>	peak drain current	T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs		-	-14	A
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = 25 °C	[2]	-	490	mW
			[1]	-	1170	mW
		T <sub>sp</sub> = 25 °C		-	8330	mW
<b>TR2 (P-channel), Source-drain diode</b>						
I <sub>S</sub>	source current	T <sub>amb</sub> = 25 °C	[1]	-	-1.2	A
<b>Per device</b>						
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

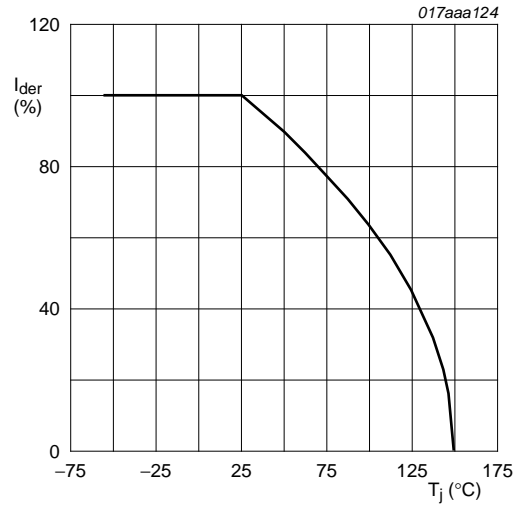
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain 6 cm<sup>2</sup>.

[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper; tin-plated and standard footprint.



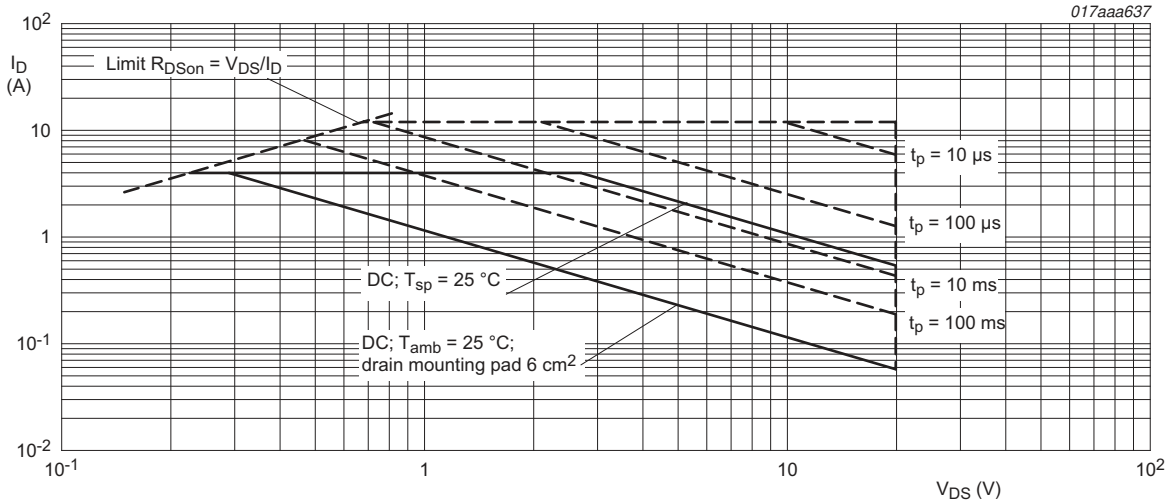
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}\text{C})}} \times 100 \%$$

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



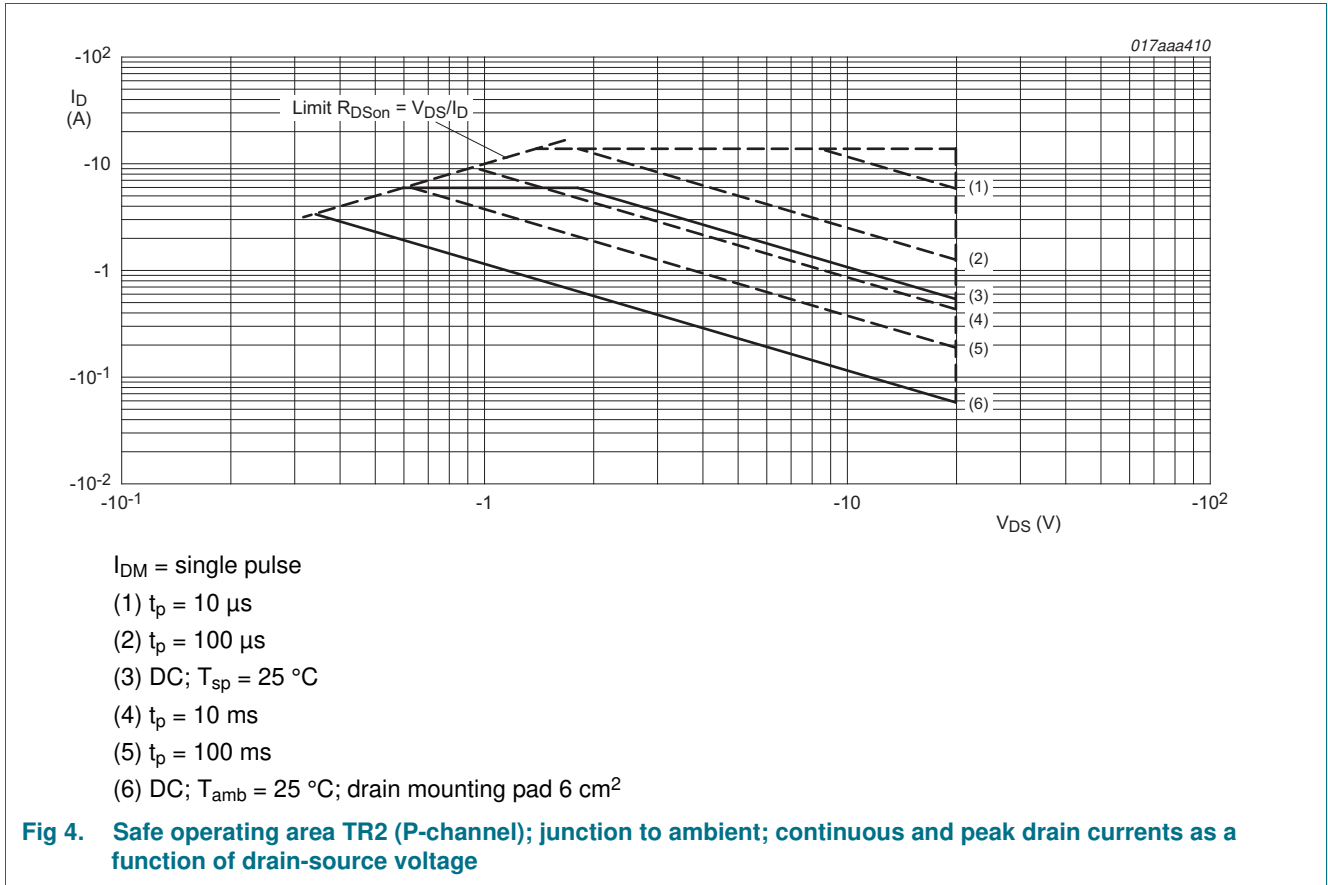
$$I_{der} = \frac{I_D}{I_{D(25^{\circ}\text{C})}} \times 100 \%$$

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



$I_{DM}$  = single pulse

Fig 3. Safe operating area TR1 (N-channel); 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
<b>TR1 (N-channel)</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	223	256	K/W
			[2]	-	93	107	K/W
			[3]	-	55	63	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	10	15	K/W
<b>TR2 (P-channel)</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	223	256	K/W
			[2]	-	93	107	K/W
			[3]	-	55	63	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	10	15	K/W

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper; tin-plated and standard footprint.

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

[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain  $6 \text{ cm}^2$ ,  $t \leq 5 \text{ s}$ .

## 7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR1 (N-channel), Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	20	-	-	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	0.65	0.9	V
$I_{DSS}$	drain leakage current	$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$	-	-	11	$\mu\text{A}$
$I_{GSS}$	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	$V_{GS} = 4.5 \text{ V}; I_D = 3 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	26	34	m $\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 3 \text{ A}; T_j = 150 \text{ }^\circ\text{C}$	-	49	63	m $\Omega$
		$V_{GS} = 2.5 \text{ V}; I_D = 1.4 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	33	46	m $\Omega$
		$V_{GS} = 1.8 \text{ V}; I_D = 1.4 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	50	69	m $\Omega$
$g_{fs}$	transfer conductance	$V_{DS} = 5 \text{ V}; I_D = 3 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	12	-	S
<b>TR1 (N-channel), Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 10 \text{ V}; I_D = 3 \text{ A}; V_{GS} = 4.5 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	14.4	21.7	nC
$Q_{GS}$	gate-source charge		-	1.1	-	nC
$Q_{GD}$	gate-drain charge		-	1.5	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 10 \text{ V}; f = 1 \text{ MHz}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	660	-	pF
$C_{oss}$	output capacitance		-	87	-	pF
$C_{rss}$	reverse transfer capacitance		-	74	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 10 \text{ V}; I_D = 3 \text{ A}; V_{GS} = 4.5 \text{ V}; R_{G(ext)} = 6 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	4	-	ns
$t_r$	rise time		-	15	-	ns
$t_{d(off)}$	turn-off delay time		-	40	-	ns
$t_f$	fall time		-	16	-	ns
<b>TR1 (N-channel), Source-drain diode characteristics</b>						
$V_{SD}$	source-drain voltage	$I_S = 1.2 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.8	1.2	V
<b>TR2 (P-channel), Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = -250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-20	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = -250 \mu\text{A}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C}$	-0.47	-0.65	-0.9	V
$I_{DSS}$	drain leakage current	$V_{DS} = -20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	-1	$\mu\text{A}$
		$V_{DS} = -20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$	-	-	-10	$\mu\text{A}$
$I_{GSS}$	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

Table 7. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = -4.5\text{ V}; I_D = -3.4\text{ A}; T_j = 25\text{ }^\circ\text{C}$	-	55	70	m $\Omega$
		$V_{GS} = -4.5\text{ V}; I_D = -3.4\text{ A}; T_j = 150\text{ }^\circ\text{C}$	-	78	99	m $\Omega$
		$V_{GS} = -2.5\text{ V}; I_D = -3\text{ A}; T_j = 25\text{ }^\circ\text{C}$	-	75	90	m $\Omega$
		$V_{GS} = -1.8\text{ V}; I_D = -1.5\text{ A}; T_j = 25\text{ }^\circ\text{C}$	-	110	135	m $\Omega$
$g_{fs}$	transfer conductance	$V_{DS} = -10\text{ V}; I_D = -3.4\text{ A}; T_j = 25\text{ }^\circ\text{C}$	-	15	-	S
<b>TR2 (P-channel), Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = -10\text{ V}; I_D = -3.4\text{ A}; V_{GS} = -5\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	8.1	12.2	nC
$Q_{GS}$	gate-source charge		-	1.2	-	nC
$Q_{GD}$	gate-drain charge		-	1.5	-	nC
$C_{iss}$	input capacitance	$V_{DS} = -10\text{ V}; f = 1\text{ MHz}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	785	-	pF
$C_{oss}$	output capacitance		-	63	-	pF
$C_{rss}$	reverse transfer capacitance		-	53	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = -10\text{ V}; I_D = -3.4\text{ A}; V_{GS} = -5\text{ V}; R_{G(ext)} = 6\text{ }\Omega; T_j = 25\text{ }^\circ\text{C}$	-	4	-	ns
$t_r$	rise time		-	14	-	ns
$t_{d(off)}$	turn-off delay time		-	40	-	ns
$t_f$	fall time		-	16	-	ns
<b>TR2 (P-channel), Source-drain diode characteristics</b>						
$V_{SD}$	source-drain voltage	$I_S = -1.2\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	-0.8	-1.2	V

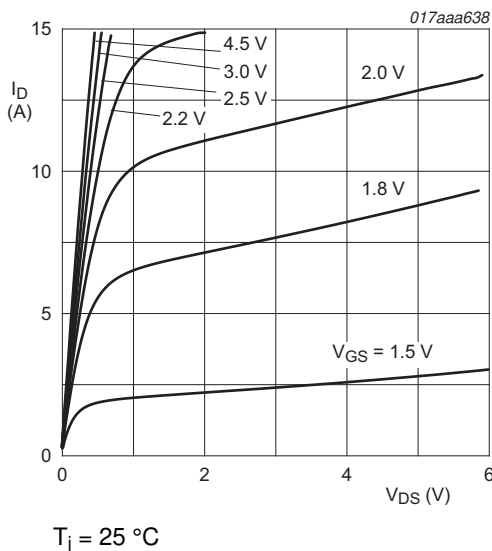


Fig 5. TR1: Output characteristics: drain current as a function of drain-source voltage; typical values

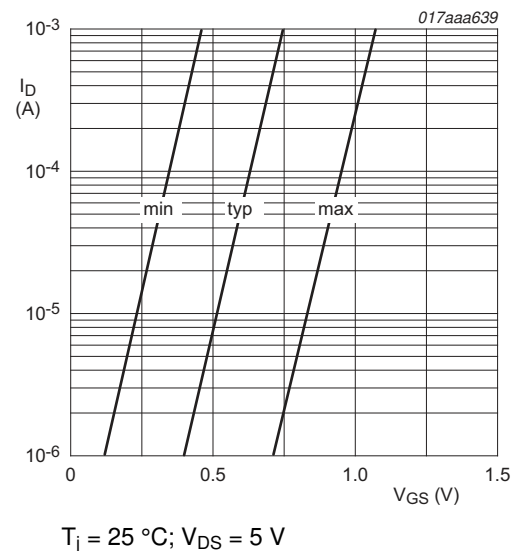
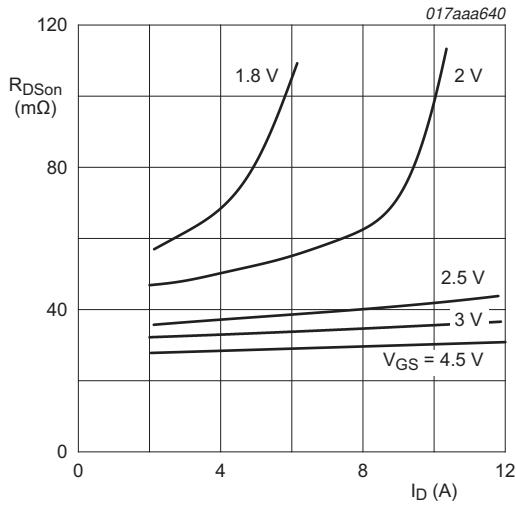
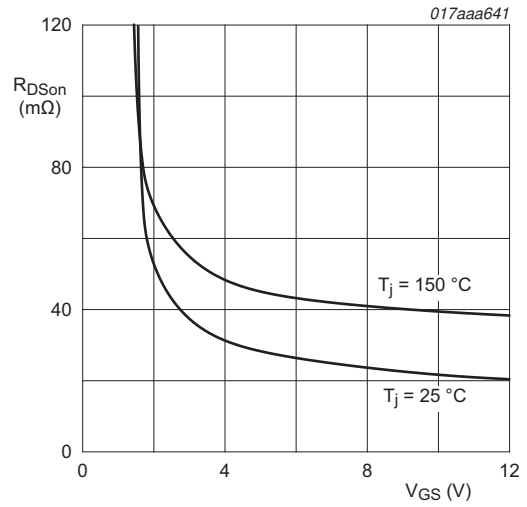


Fig 6. TR1: Sub-threshold drain current as a function of gate-source voltage



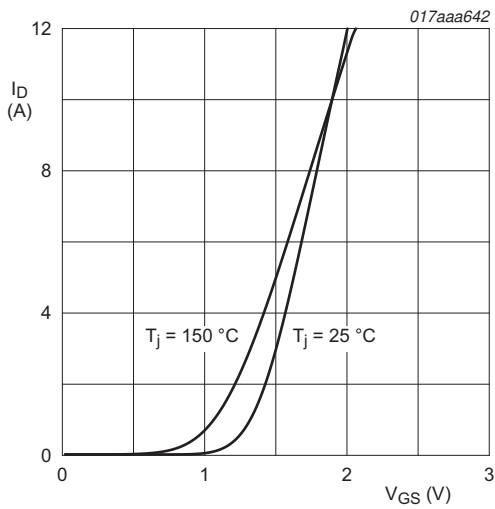
$T_j = 25\text{ }^\circ\text{C}$

Fig 7. TR1: Drain-source on-state resistance as a function of drain current; typical values



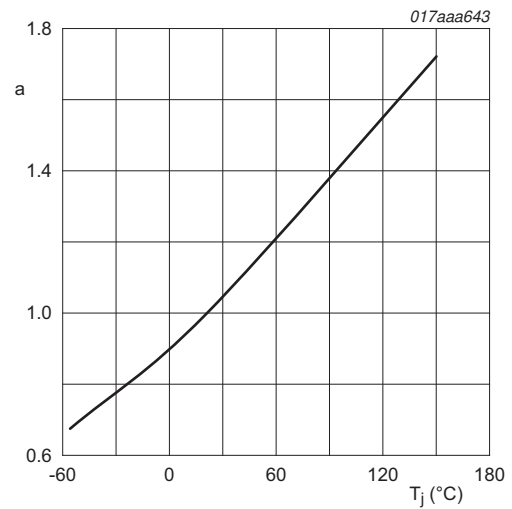
$I_D = 2\text{ A}$

Fig 8. TR1: Drain-source on-state resistance as a function of gate-source voltage; typical values



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

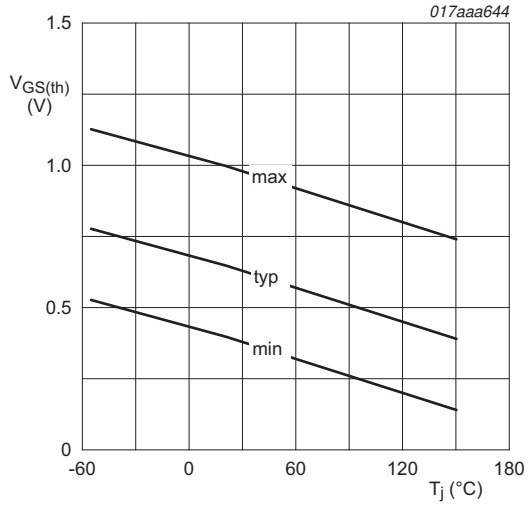
Fig 9. TR1: Transfer characteristics: drain current as a function of gate-source voltage; typical values



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

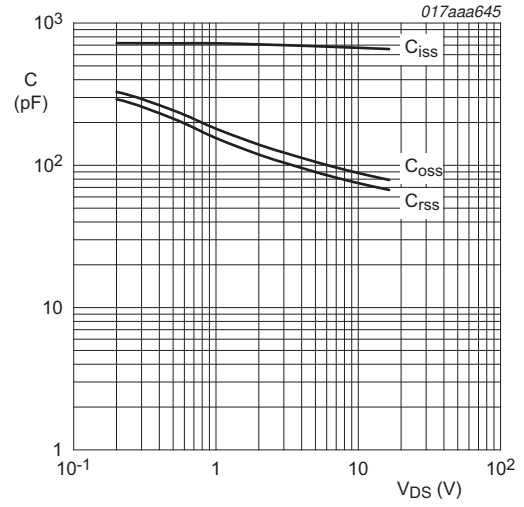
Fig 10. TR1: Normalized drain-source on-state resistance as a function of junction temperature; typical values





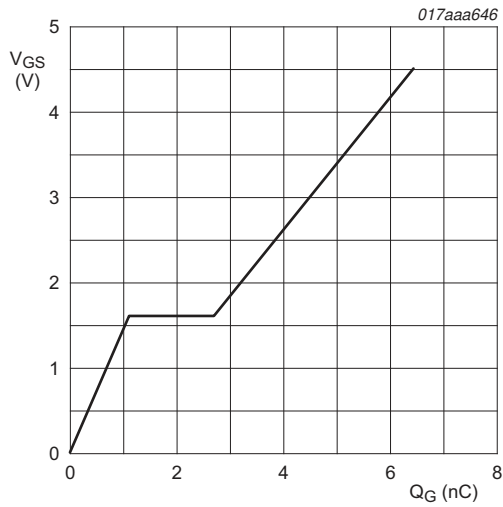
$I_D = 0.25 \text{ mA}; V_{DS} = V_{GS}$

Fig 11. TR1: Gate-source threshold voltage as a function of junction temperature



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

Fig 12. TR1: Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$I_D = 3 \text{ A}; V_{DS} = 10 \text{ V}; T_{amb} = 25 \text{ }^{\circ}C$

Fig 13. TR1: Gate-source voltage as a function of gate charge; typical values

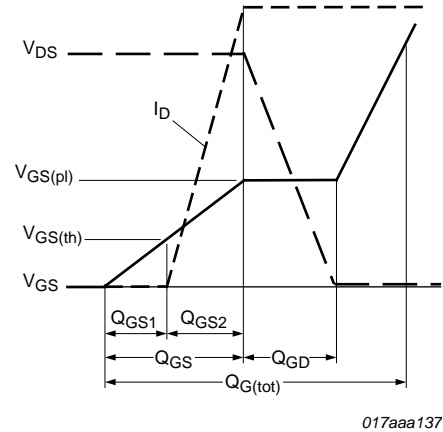
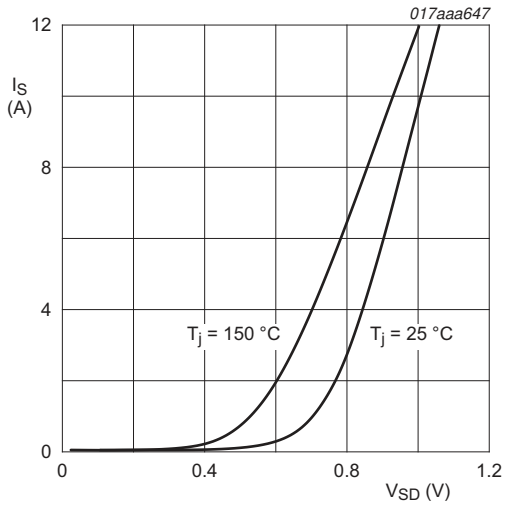
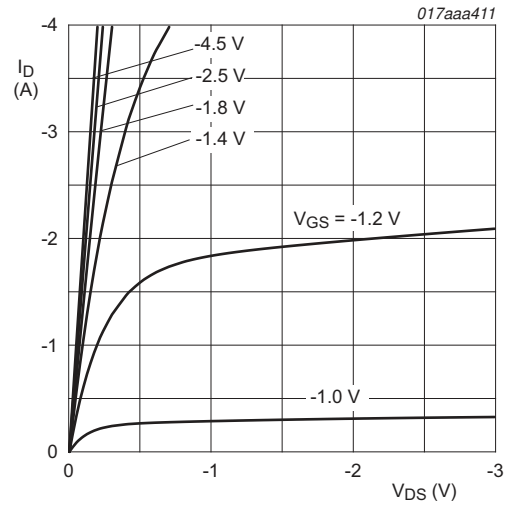


Fig 14. Gate charge waveform definitions



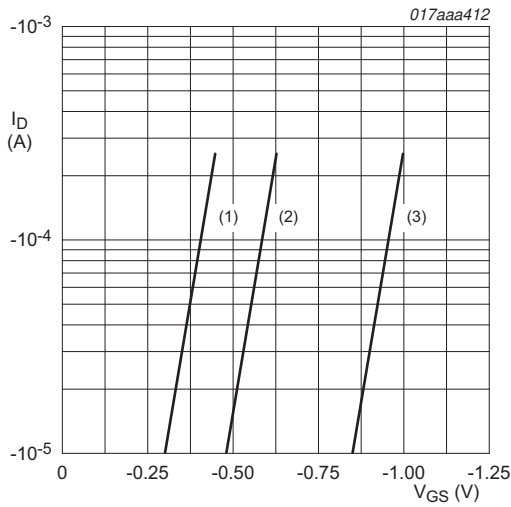
$V_{GS} = 0 \text{ V}$

**Fig 15. TR1: Source current as a function of source-drain voltage; typical values**



$T_j = 25 \text{ °C}$

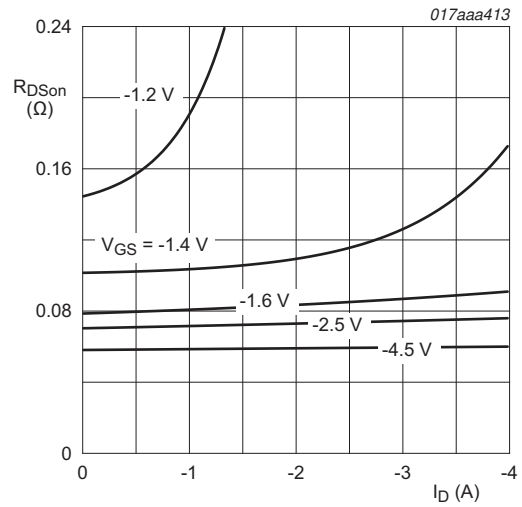
**Fig 16. TR2: Output characteristics: drain current as a function of drain-source voltage; typical values**



$T_j = 25 \text{ °C}; V_{DS} = -5 \text{ V}$

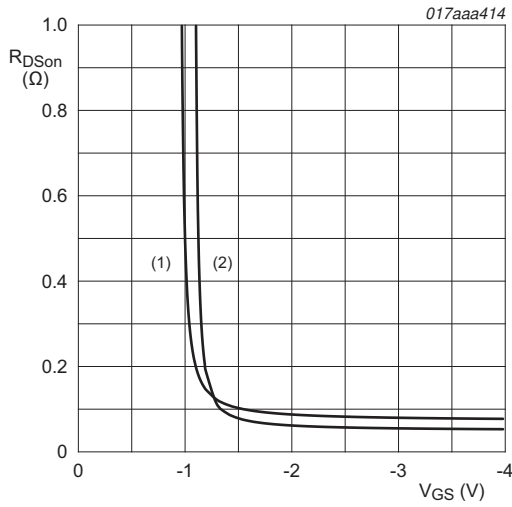
- (1) minimum values
- (2) typical values
- (3) maximum values

**Fig 17. TR2: Sub-threshold drain current as a function of gate-source voltage**



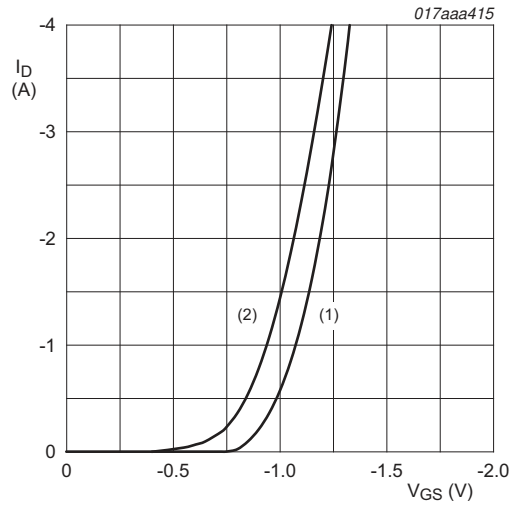
$T_j = 25 \text{ °C}$

**Fig 18. TR2: Drain-source on-state resistance as a function of drain current; typical values**



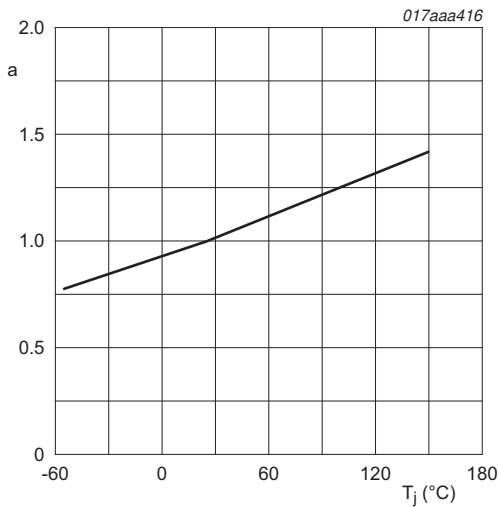
$I_D = -1 \text{ A}$   
 (1)  $T_j = 150 \text{ °C}$   
 (2)  $T_j = 25 \text{ °C}$

**Fig 19. TR2: Drain-source on-state resistance as a function of gate-source voltage; typical values**



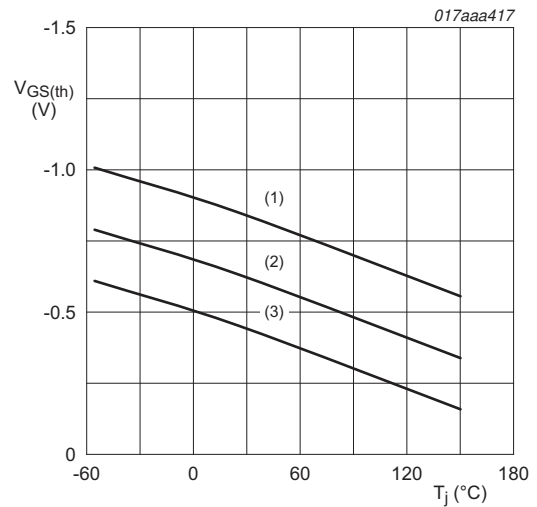
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25 \text{ °C}$   
 (2)  $T_j = 150 \text{ °C}$

**Fig 20. TR2: Transfer characteristics: drain current as a function of gate-source voltage; typical values**



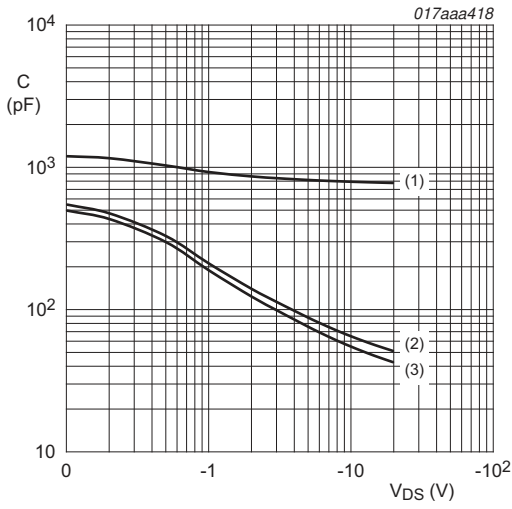
$$\alpha = \frac{R_{DS(on)}}{R_{DS(on)(25^\circ\text{C})}}$$

**Fig 21. TR2: Normalized drain-source on-state resistance as a function of junction temperature; typical values**



$I_D = -0.25 \text{ mA}; V_{DS} = V_{GS}$   
 (1) maximum values  
 (2) typical values  
 (3) minimum values

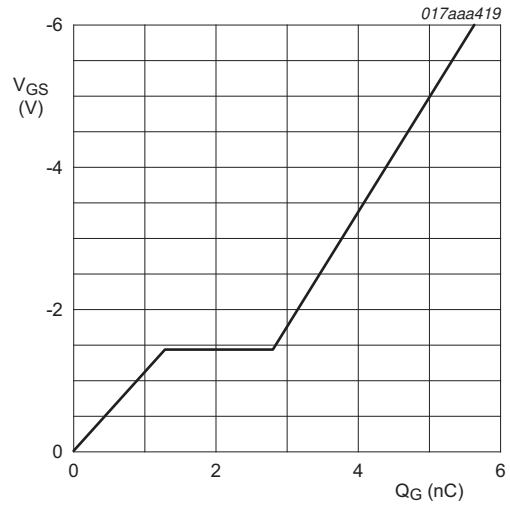
**Fig 22. TR2: Gate-source threshold voltage as a function of junction temperature**



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

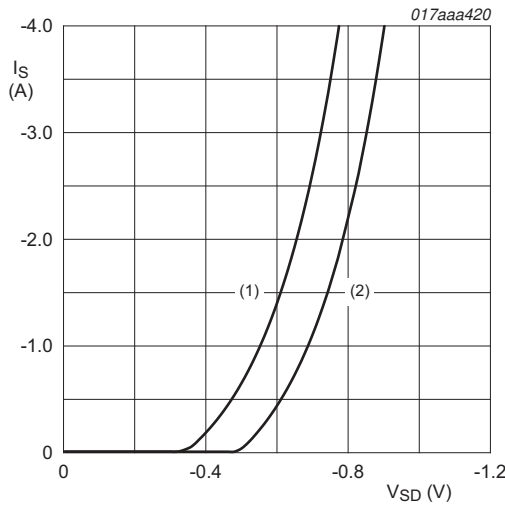
- (1)  $C_{iss}$
- (2)  $C_{oss}$
- (3)  $C_{rss}$

**Fig 23. TR2: Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



$I_D = -3.3 \text{ A}; V_{DS} = -10 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig 24. TR2: Gate-source voltage as a function of gate charge; typical values**



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

- (1)  $T_{amb} = 150 \text{ }^\circ\text{C}$
- (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig 25. TR2: Source current as a function of source-drain voltage; typical values**

## 8. Test information

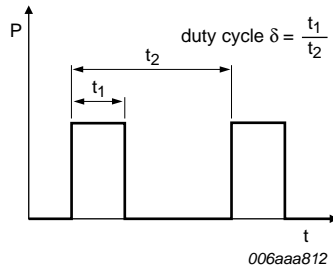


Fig 26. Duty cycle definition

## 9. Package outline

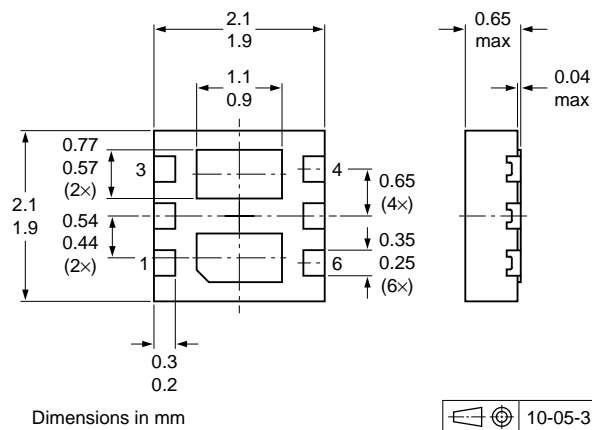
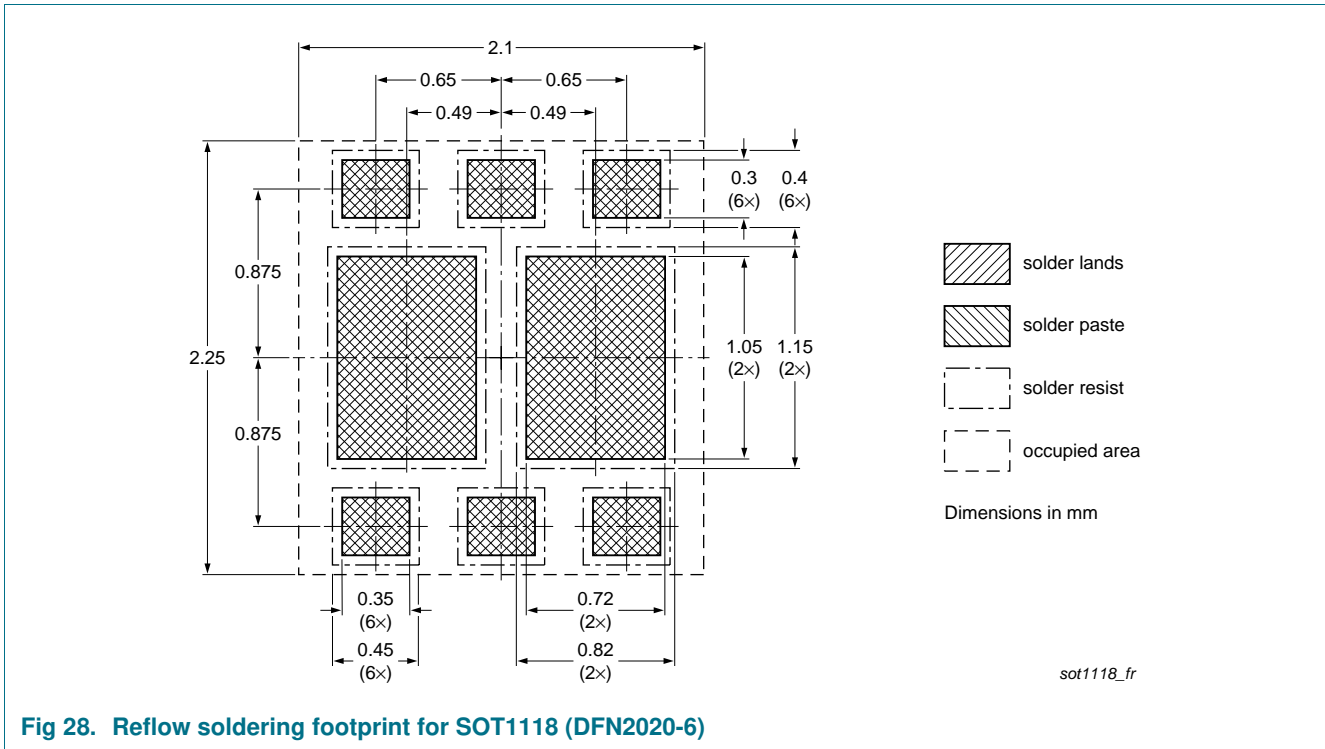


Fig 27. DFN2020-6 (SOT1118)

10. Soldering



## 11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PMCPB5530X v.1	20120626	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.

[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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