

# PMFPB8040XP

20 V, 3.7 A / 440 mV  $V_F$  P-channel MOSFET-Schottky combination

21 December 2012

Product data sheet

## 1. General description

Small-signal P-channel enhancement mode Field-Effect Transistor (FET) using Trench MOSFET technology and ultra low  $V_F$  Maximum Efficiency General Application (MEGA) Schottky diode combined in a small and leadless ultra thin DFN2020-6 (SOT1118) Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- 1.8 V  $R_{DSon}$  rated for low-voltage gate drive
- Small and leadless ultra thin SMD plastic package: 2 × 2 × 0.65 mm
- Exposed drain pad for excellent thermal conduction
- Integrated ultra low  $V_F$  MEGA Schottky diode

## 3. Applications

- Charging switch for portable devices
- DC-to-DC converters
- Power management in battery-driven portables
- Hard disk and computing power management

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>MOSFET transistor</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]	-	-3.7	A
<b>Schottky diode</b>						
$I_F$	forward current	$T_{sp} \leq 105\text{ °C}$	-	-	2	A
$V_R$	reverse voltage	$T_{amb} = 25\text{ °C}$	-	-	30	V
<b>MOSFET transistor static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = -4.5\text{ V}; I_D = -2.7\text{ A}; T_j = 25\text{ °C}$	-	80	102	mΩ

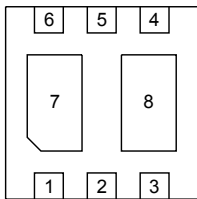
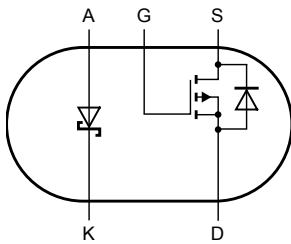


Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Schottky diode</b>						
$V_F$	forward voltage	$I_F = 1\text{ A}; T_j = 25\text{ °C}$	-	440	520	mV

[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	A	anode	 <p>Transparent top view <b>DFN2020-6 (SOT1118)</b></p>	 <p>aaa-003667</p>
2	n.c.	not connected		
3	D	drain		
4	S	source		
5	G	gate		
6	K	cathode		
7	K	cathode		
8	D	drain		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMFPB8040XP	DFN2020-6	plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals; body 2 x 2 x 0.65 mm	SOT1118

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PMFPB8040XP	1Y

## 8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
<b>MOSFET transistor</b>					
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-20	V

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Symbol	Parameter	Conditions		Min	Max	Unit
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]	-	-3.7	A
		V <sub>GS</sub> = -4.5 V; T <sub>amb</sub> = 25 °C	[1]	-	-2.7	A
		V <sub>GS</sub> = -4.5 V; T <sub>amb</sub> = 100 °C	[1]	-	-1.7	A
I <sub>DM</sub>	peak drain current	T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs		-	-11	A
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = 25 °C	[2]	-	485	mW
			[1]	-	1100	mW
		T <sub>sp</sub> = 25 °C		-	6250	mW
<b>Source-drain diode</b>						
I <sub>S</sub>	source current	T <sub>amb</sub> = 25 °C	[1]	-	-1.1	A
<b>Schottky diode</b>						
V <sub>R</sub>	reverse voltage	T <sub>amb</sub> = 25 °C		-	30	V
I <sub>F</sub>	forward current	T <sub>sp</sub> ≤ 105 °C		-	2	A
I <sub>FRM</sub>	repetitive peak forward current	t <sub>p</sub> ≤ 1 ms; δ ≤ 0.25 ; T <sub>amb</sub> = 25 °C		-	7	A
I <sub>FSM</sub>	non-repetitive peak forward current	t <sub>p</sub> = 8 ms; T <sub>j(init)</sub> = 25 °C; square wave		-	18	A
		t <sub>p</sub> = 8 ms; T <sub>j(init)</sub> = 25 °C; half-sine wave	[3]	-	25	A
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = 25 °C	[2]	-	480	mW
			[1]	-	1190	mW
		T <sub>sp</sub> = 25 °C		-	6250	mW
<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, mounting pad for drain 6 cm<sup>2</sup>.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [3] Calculated from square-wave measurements.

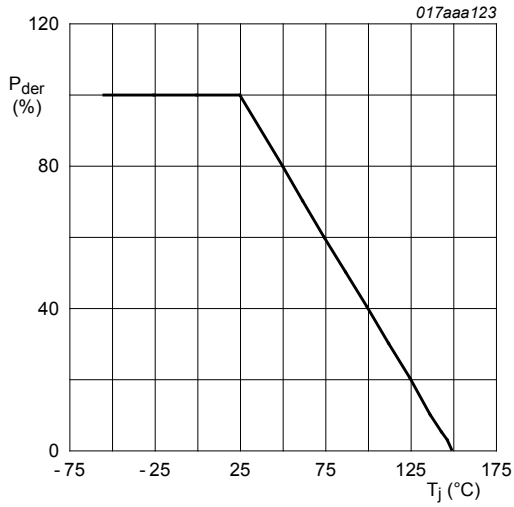


Fig. 1. MOSFET transistor: Normalized total power dissipation as a function of junction temperature

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

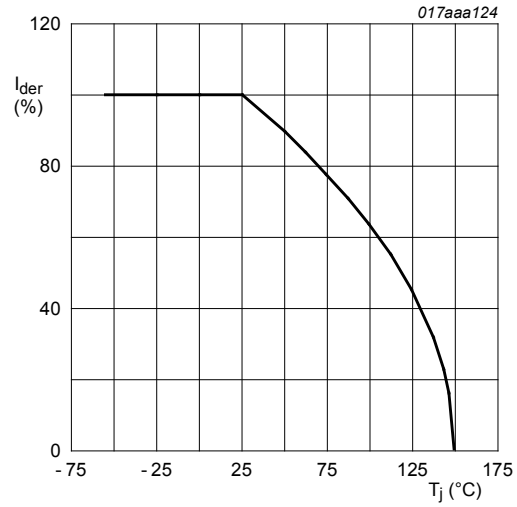
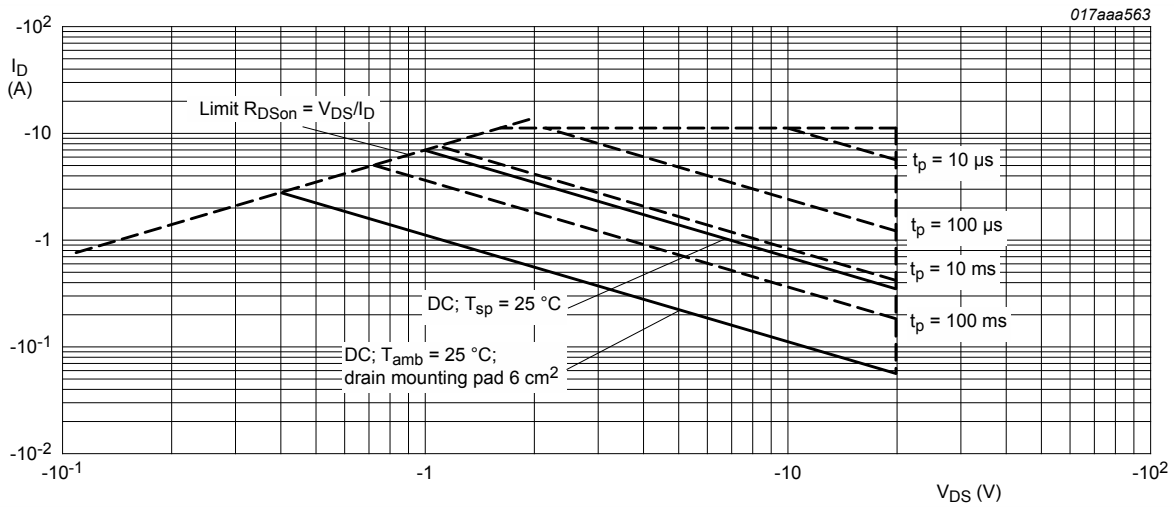


Fig. 2. MOSFET transistor: Normalized continuous drain current as a function of junction temperature

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



$I_{DM}$  = single pulse

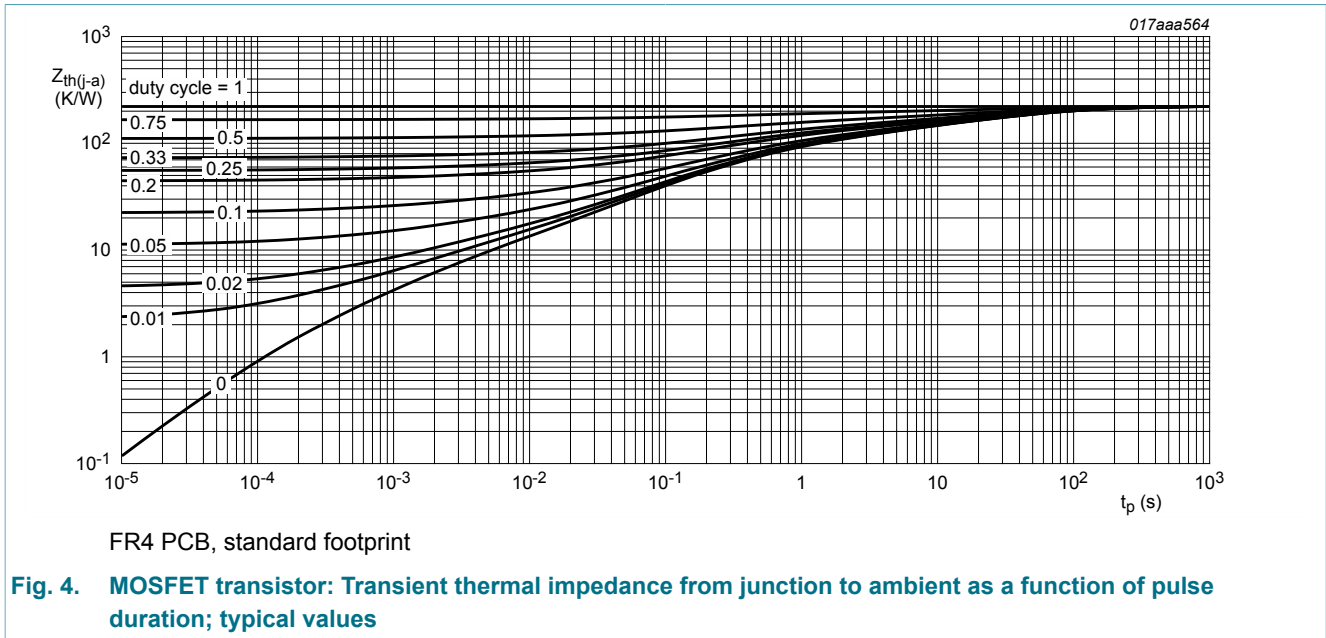
Fig. 3. MOSFET transistor: Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

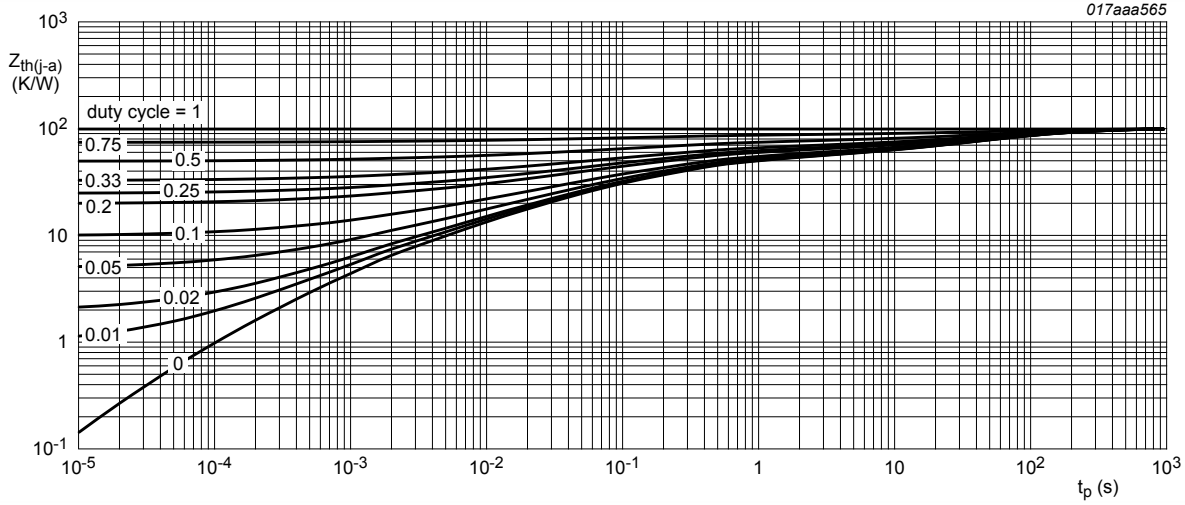
### 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>MOSFET transistor</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	225	260	K/W
			[2]	-	99	115	K/W
		in free air; $t \leq 5$ s	[2]	-	54	62	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	16	20	K/W
<b>Schottky diode</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	260	K/W
			[2]	-	-	105	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	20	K/W

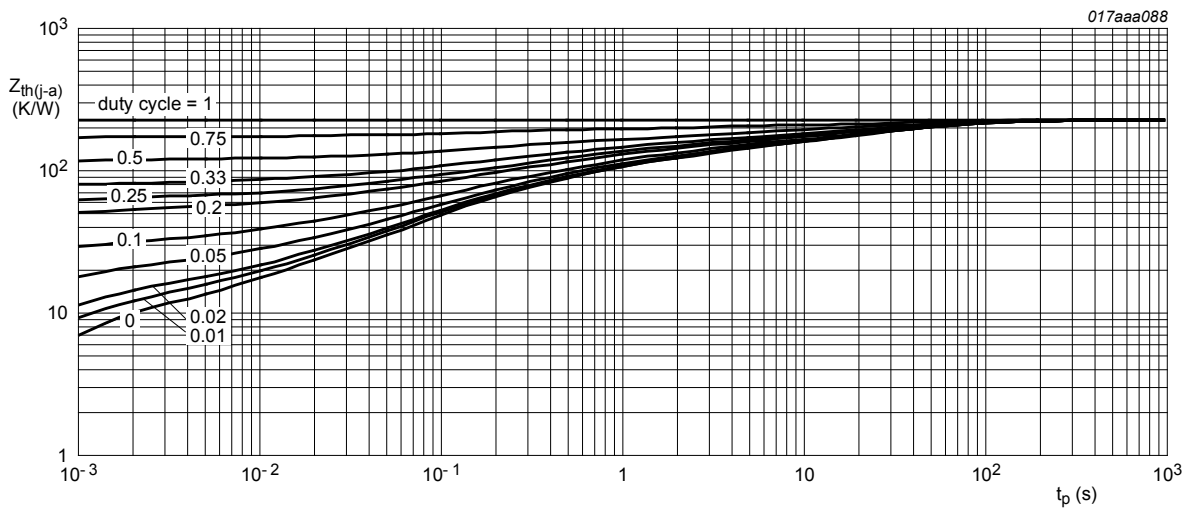
- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm<sup>2</sup>.





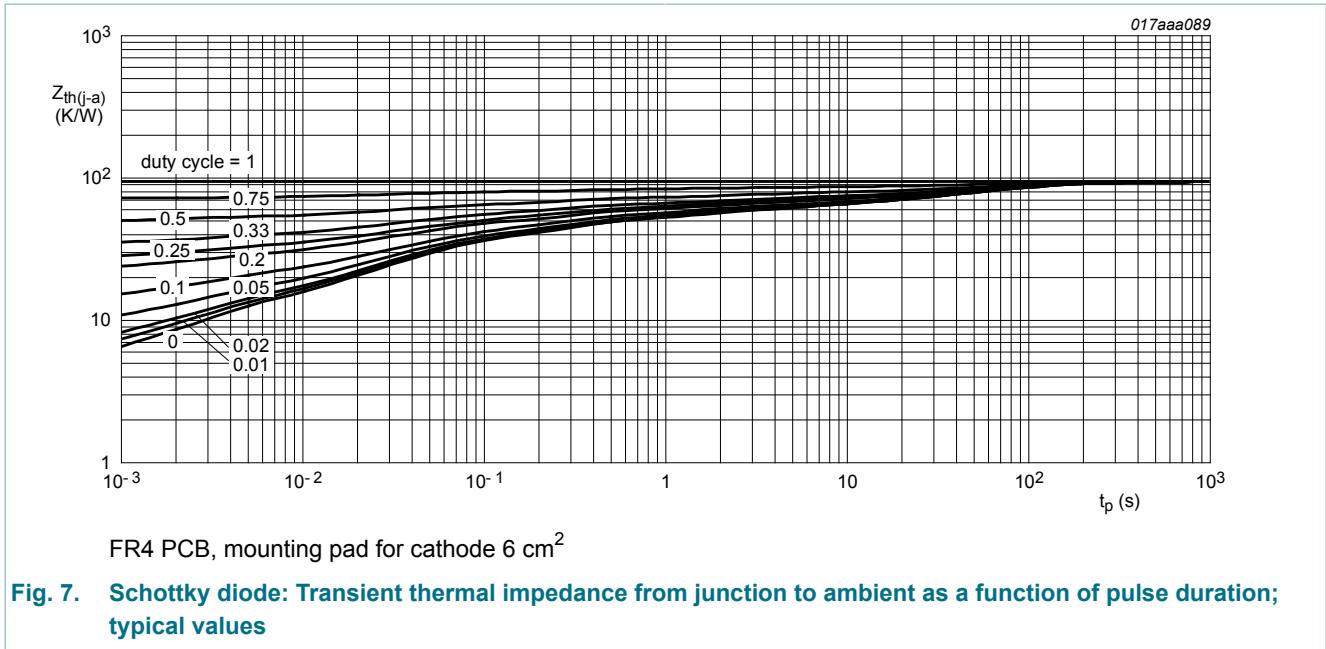
FR4 PCB, mounting pad for drain  $6\text{ cm}^2$

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



FR4 PCB, standard footprint

Fig. 6. Schottky diode: 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>MOSFET transistor 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	-0.6	-1	V
$I_{DSS}$	drain leakage current	$V_{DS} = -20 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	-1	$\mu A$
		$V_{DS} = -20 V; V_{GS} = 0 V; T_j = 150 \text{ }^\circ C$	-	-	-10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = -12 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	-100	nA
		$V_{GS} = 12 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = -4.5 V; I_D = -2.7 A; T_j = 25 \text{ }^\circ C$	-	80	102	m $\Omega$
		$V_{GS} = -4.5 V; I_D = -2.7 A; T_j = 150 \text{ }^\circ C$	-	116	148	m $\Omega$
		$V_{GS} = -2.5 V; I_D = -2.5 A; T_j = 25 \text{ }^\circ C$	-	95	125	m $\Omega$
		$V_{GS} = -1.8 V; I_D = -1.1 A; T_j = 25 \text{ }^\circ C$	-	120	156	m $\Omega$
$g_{fs}$	transfer conductance	$V_{DS} = -10 V; I_D = -2.7 A; T_j = 25 \text{ }^\circ C$	-	15	-	S
<b>MOSFET transistor dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = -10 V; I_D = -2.7 A; V_{GS} = -4.5 V; T_j = 25 \text{ }^\circ C$	-	5.7	8.6	nC
$Q_{GS}$	gate-source charge		-	0.7	-	nC
$Q_{GD}$	gate-drain charge		-	0.96	-	nC

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{iss}$	input capacitance	$V_{DS} = -10\text{ V}; f = 1\text{ MHz}; V_{GS} = 0\text{ V};$	-	550	-	pF
$C_{oss}$	output capacitance	$T_j = 25\text{ }^\circ\text{C}$	-	63	-	pF
$C_{rss}$	reverse transfer capacitance		-	53	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = -10\text{ V}; I_D = -2.4\text{ A}; V_{GS} = -4.5\text{ V};$	-	6	-	ns
$t_r$	rise time	$R_{G(ext)} = 6\text{ }\Omega; T_j = 25\text{ }^\circ\text{C}$	-	14	-	ns
$t_{d(off)}$	turn-off delay time		-	120	-	ns
$t_f$	fall time		-	50	-	ns
<b>MOSFET transistor source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = -1.1\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	-0.8	-1.2	V
<b>Schottky diode</b>						
$V_F$	forward voltage	$I_F = 100\text{ mA}; T_j = 25\text{ }^\circ\text{C}$	-	330	390	mV
		$I_F = 500\text{ mA}; T_j = 25\text{ }^\circ\text{C}$	-	400	460	mV
		$I_F = 1\text{ A}; T_j = 25\text{ }^\circ\text{C}$	-	440	520	mV
$I_R$	reverse current	$V_R = 5\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	1	3.5	$\mu\text{A}$
		$V_R = 5\text{ V}; T_j = 125\text{ }^\circ\text{C}$	-	0.33	1.2	mA
		$V_R = 10\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	2	5	$\mu\text{A}$
		$V_R = 20\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	4	15	$\mu\text{A}$
		$V_R = 30\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	8	30	$\mu\text{A}$
$C_d$	diode capacitance	$V_R = 5\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ }^\circ\text{C}$	-	45	55	pF

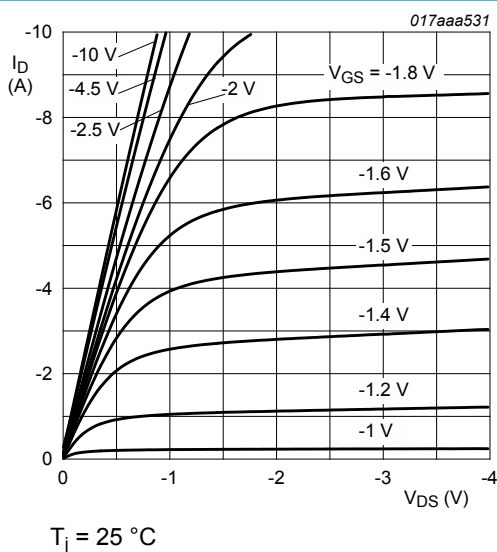


Fig. 8. MOSFET transistor: Output characteristics: drain current as a function of drain-source voltage; typical values

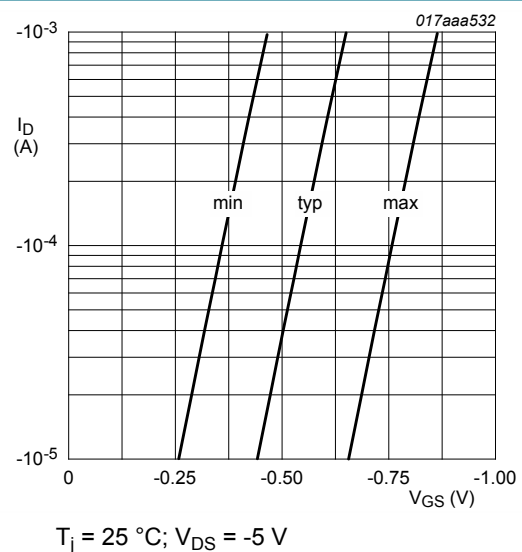


Fig. 9. MOSFET transistor: Subthreshold drain current as a function of gate-source voltage



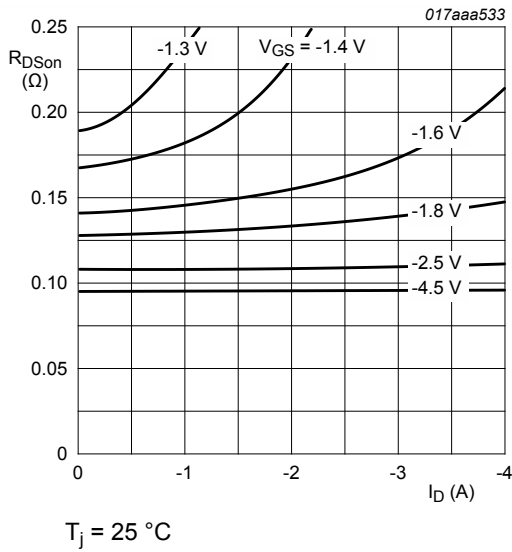


Fig. 10. MOSFET transistor: Drain-source on-state resistance as a function of drain current; typical values

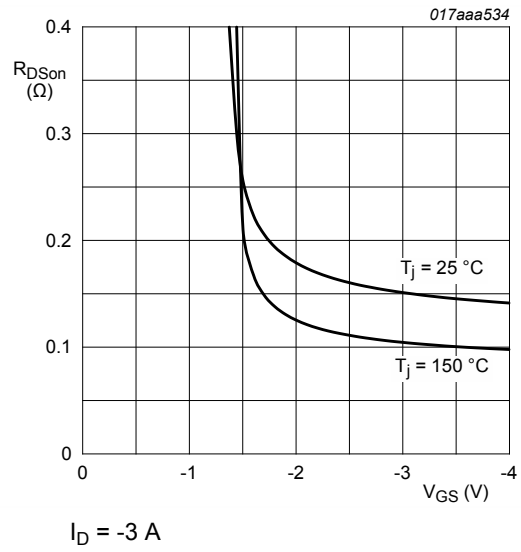


Fig. 11. MOSFET transistor: Drain-source on-state resistance as a function of gate-source voltage; typical values

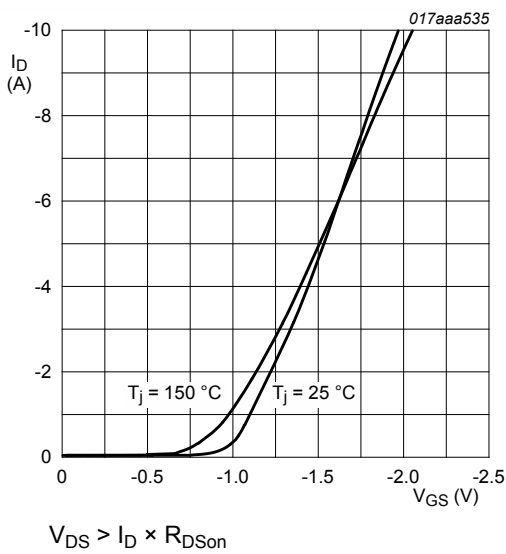


Fig. 12. MOSFET transistor: Transfer characteristics: drain current as a function of gate-source voltage; typical values

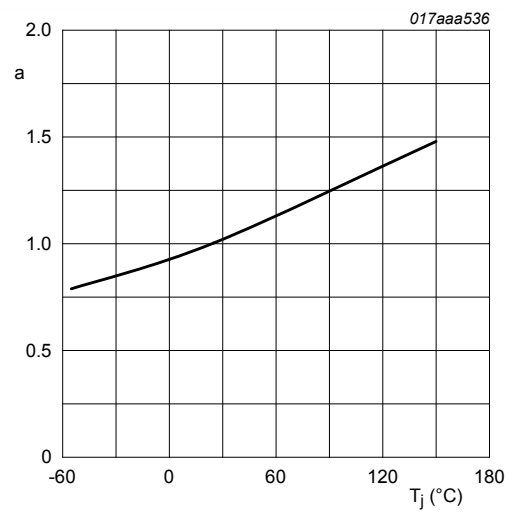
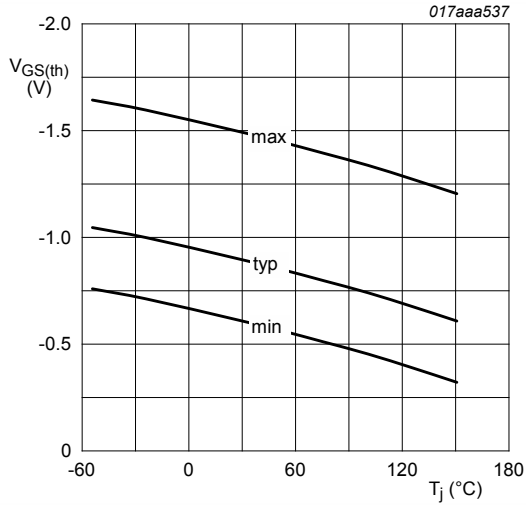


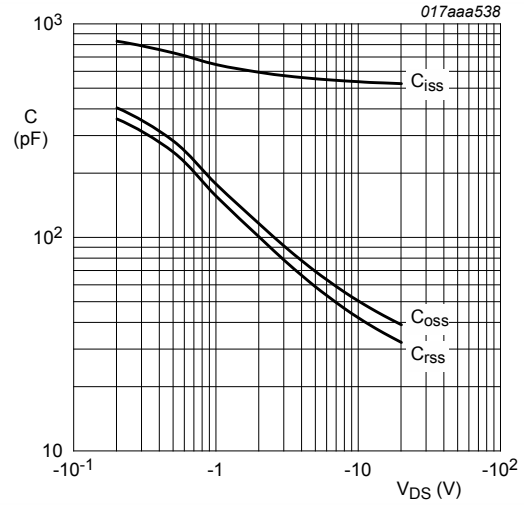
Fig. 13. MOSFET transistor: Normalized drain-source on-state resistance as a function of junction temperature; typical values

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



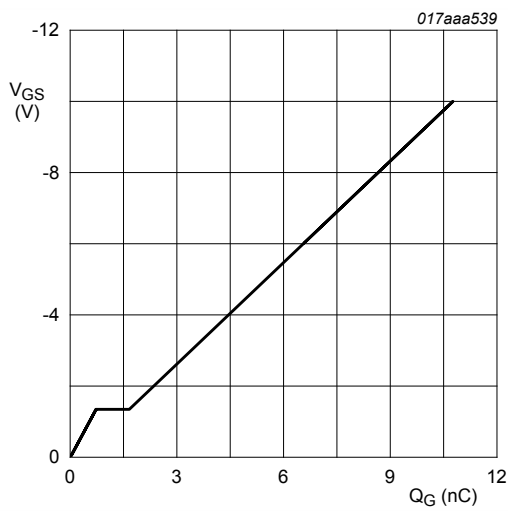
$I_D = -0.25$  mA;  $V_{DS} = V_{GS}$

Fig. 14. MOSFET transistor: Gate-source threshold voltage as a function of junction temperature



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

Fig. 15. MOSFET transistor: Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$I_D = -3$  A;  $V_{DS} = -10$  V;  $T_{amb} = 25$  °C

Fig. 16. MOSFET transistor: Gate-source voltage as a function of gate charge; typical values

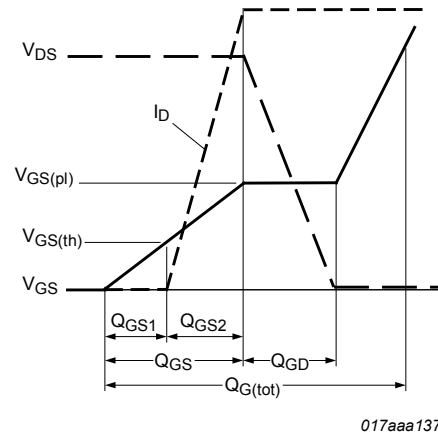


Fig. 17. MOSFET transistor: Gate charge waveform definitions

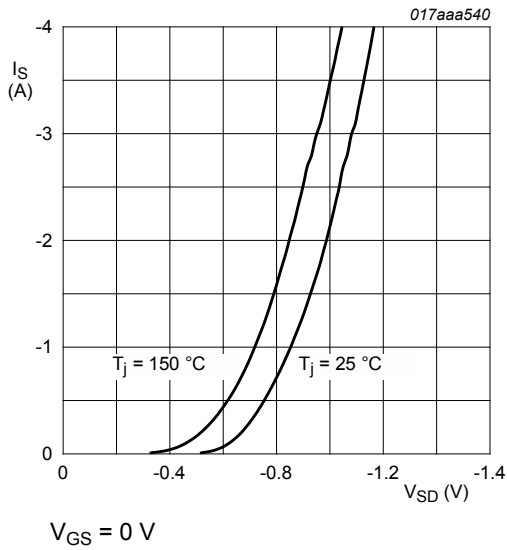
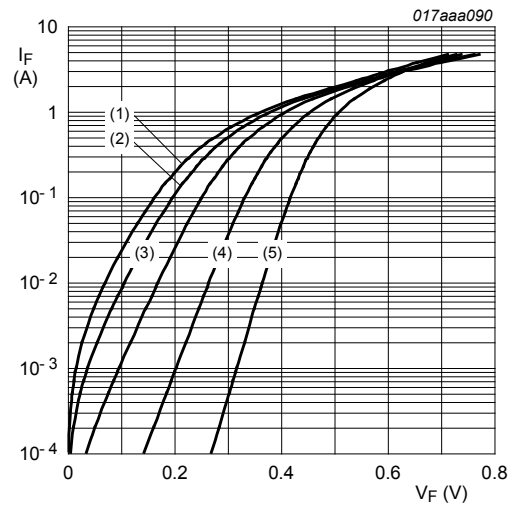
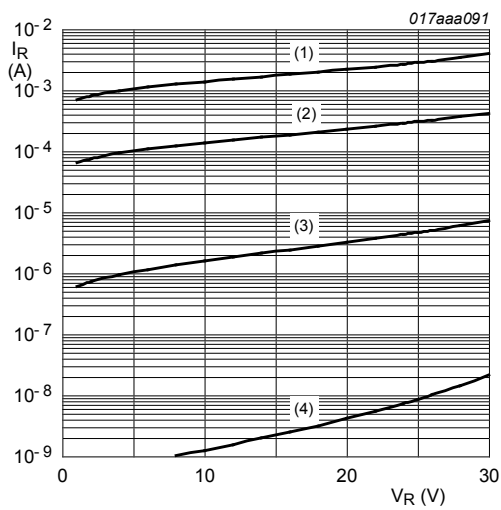


Fig. 18. MOSFET transistor: Source current as a function of source-drain voltage; typical values



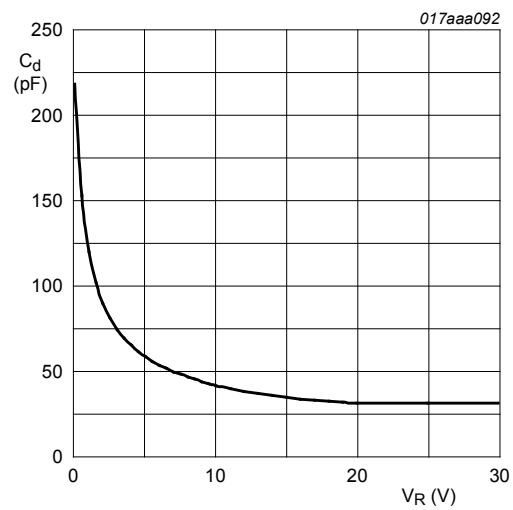
- (1)  $T_j = 150\text{ }^\circ\text{C}$
- (2)  $T_j = 125\text{ }^\circ\text{C}$
- (3)  $T_j = 85\text{ }^\circ\text{C}$
- (4)  $T_j = 25\text{ }^\circ\text{C}$
- (5)  $T_j = -40\text{ }^\circ\text{C}$

Fig. 19. Schottky diode: Forward current as a function of forward voltage; typical values



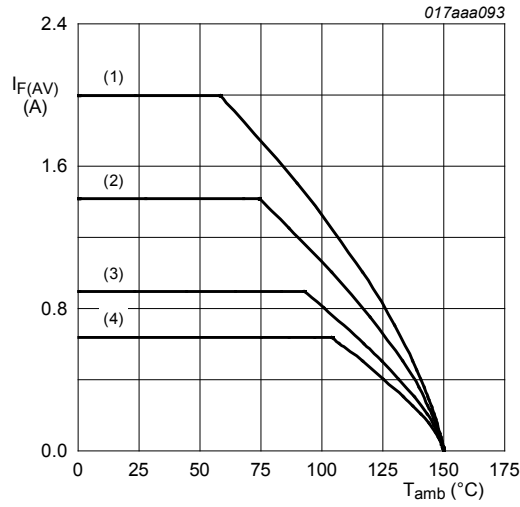
- (1)  $T_j = 125\text{ }^\circ\text{C}$
- (2)  $T_j = 85\text{ }^\circ\text{C}$
- (3)  $T_j = 25\text{ }^\circ\text{C}$
- (4)  $T_j = -40\text{ }^\circ\text{C}$

Fig. 20. Schottky diode: Reverse current as a function of reverse voltage; typical values



$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$

Fig. 21. Schottky diode: Diode capacitance as a function of reverse voltage; typical values



FR4 PCB, mounting pad for cathode 6 cm<sup>2</sup>  
 T<sub>j</sub> = 150 °C  
 (1) δ = 1; DC  
 (2) δ = 0.5; f = 20 kHz  
 (3) δ = 0.2; f = 20 kHz  
 (4) δ = 0.1; f = 20 kHz

Fig. 22. Schottky diode: Average forward current as a function of ambient temperature; typical values

## 11. Test information

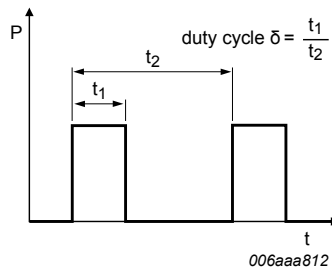


Fig. 23. Duty cycle definition

### 12. Package outline

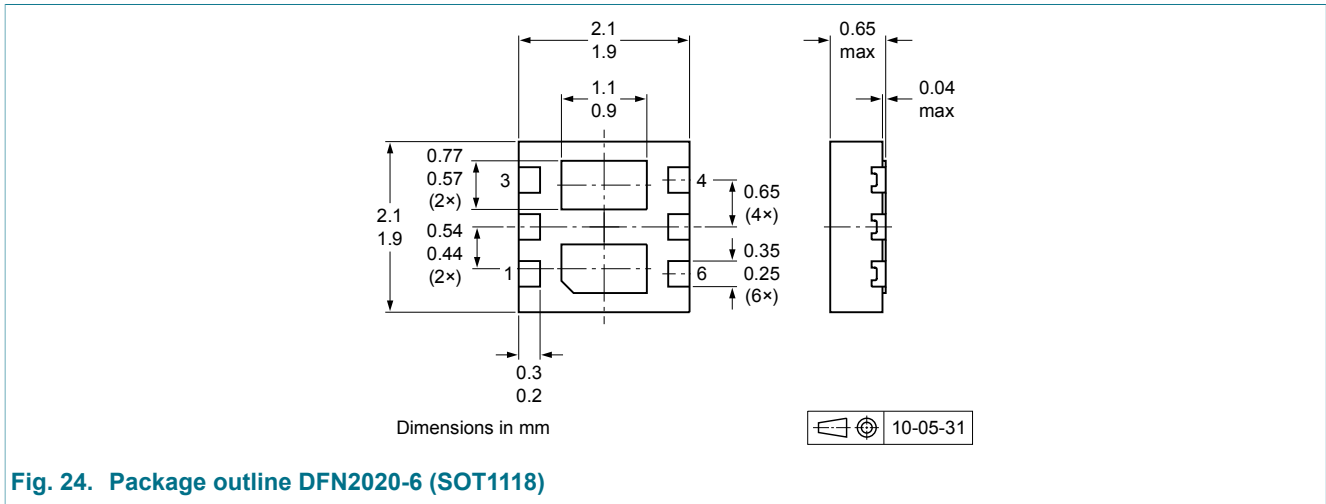


Fig. 24. Package outline DFN2020-6 (SOT1118)

### 13. Soldering

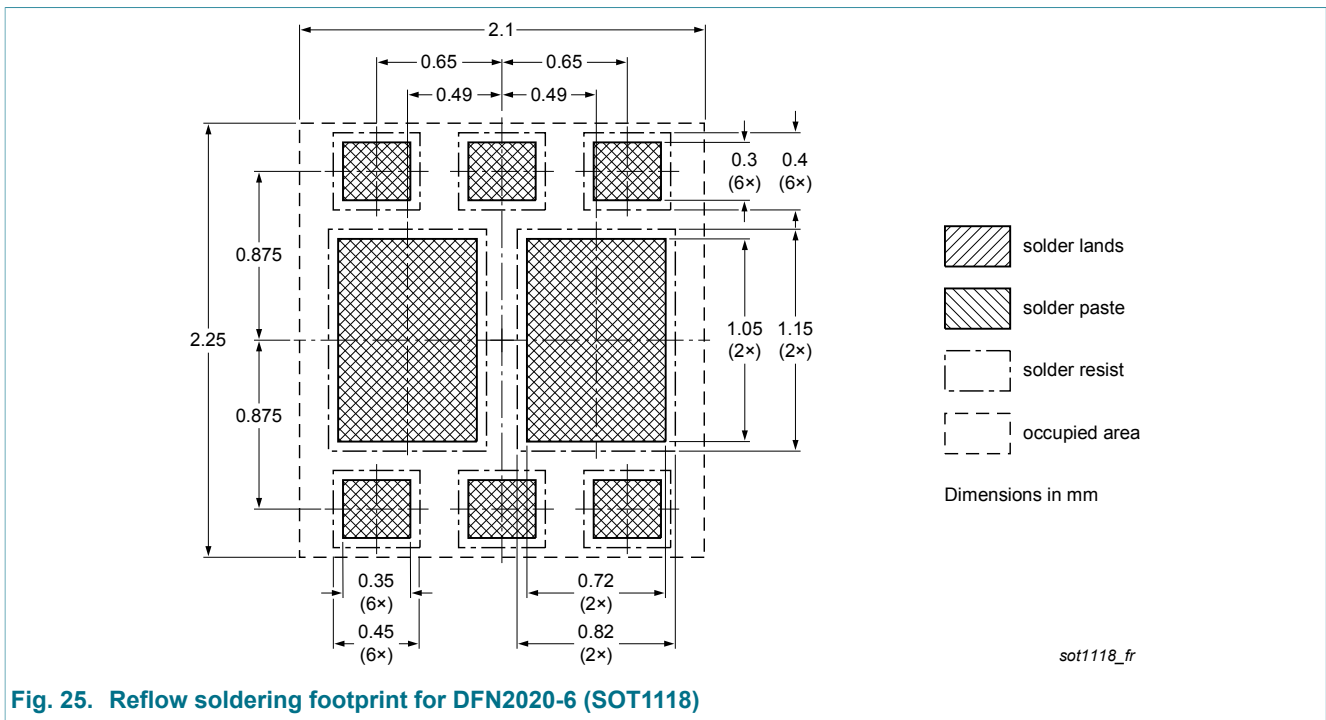


Fig. 25. Reflow soldering footprint for DFN2020-6 (SOT1118)

### 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMFPB8040XP v.1	20121221	Product data sheet	-	-

## 15. Legal information

### 15.1 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".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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Date of release: 21 December 2012