



# 2N7002BKMB

60 V, single N-channel Trench MOSFET

Rev. 2 — 13 June 2012

Product data sheet

## 1. Product profile

### 1.1 General description

N-channel enhancement mode Field-Effect Transistor (FET) in a leadless ultra small DFN1006B-3 (SOT883B) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

### 1.2 Features and benefits

- Very fast switching
- Trench MOSFET technology
- ESD protection up to 2 kV
- Logic-level compatible
- Ultra thin package profile with 0.37 mm height

### 1.3 Applications

- Relay driver
- High-speed line driver
- Low-side loadswitch
- Switching circuits

### 1.4 Quick reference data

Table 1. Quick reference data

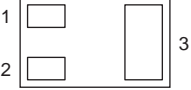
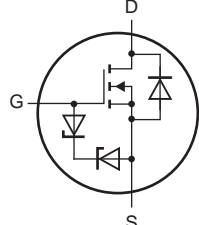
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	60	V
$V_{GS}$	gate-source voltage		-20	-	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$	<a href="#">[1]</a>	-	450	mA
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 450\text{ mA}; T_j = 25\text{ °C}$	-	1	1.6	$\Omega$

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 1 cm<sup>2</sup>.



## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p>Transparent top view</p> <p><b>SOT883B (DFN1006B-3)</b></p>	 <p>017aaa255</p>
2	S	source		
3	D	drain		

## 3. Ordering information

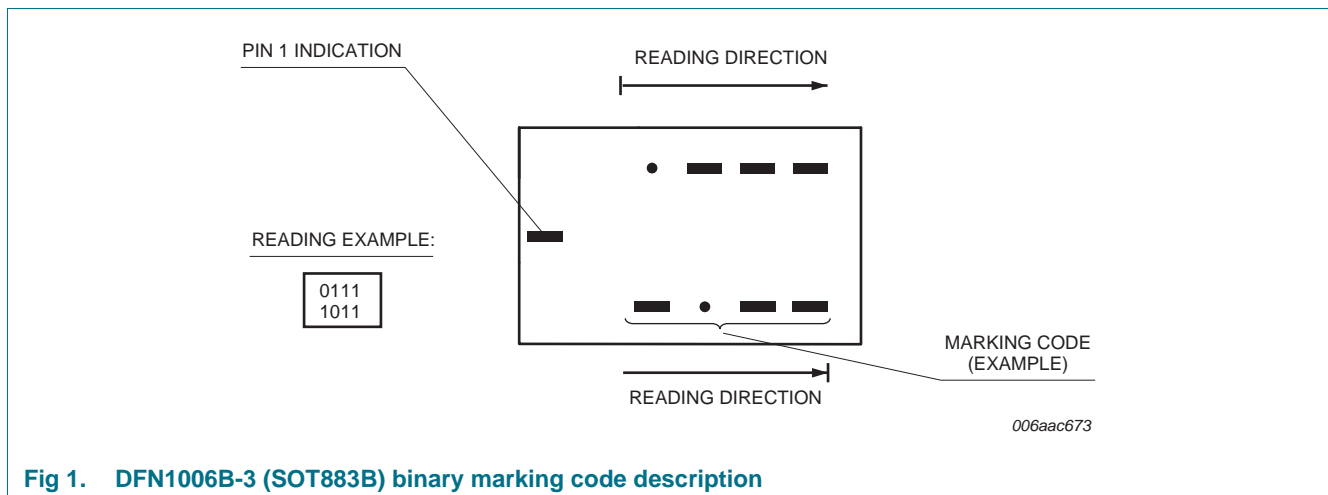
Table 3. Ordering information

Type number	Package		
	Name	Description	Version
2N7002BKMB	DFN1006B-3	Leadless ultra small plastic package; 3 solder lands; body 1.0 x 0.6 x 0.37 mm	SOT883B

## 4. Marking

Table 4. Marking codes

Type number	Marking code
2N7002BKMB	0000 0001



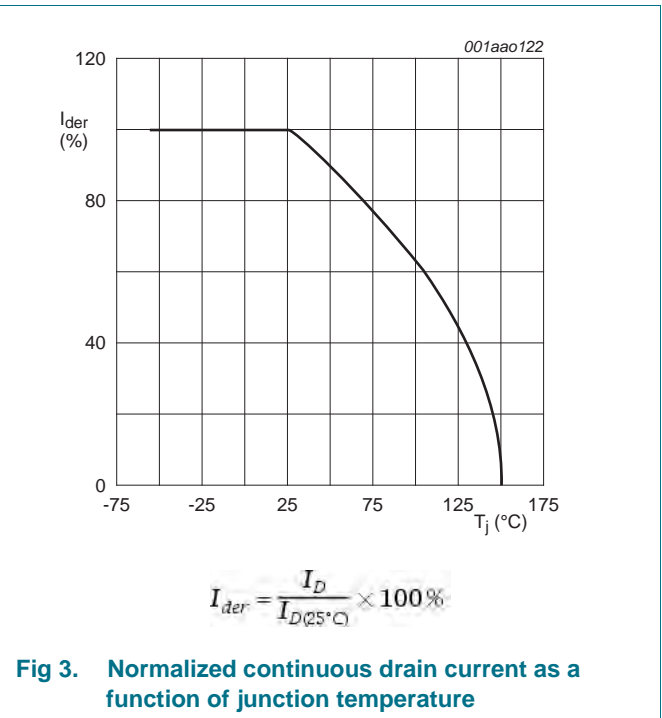
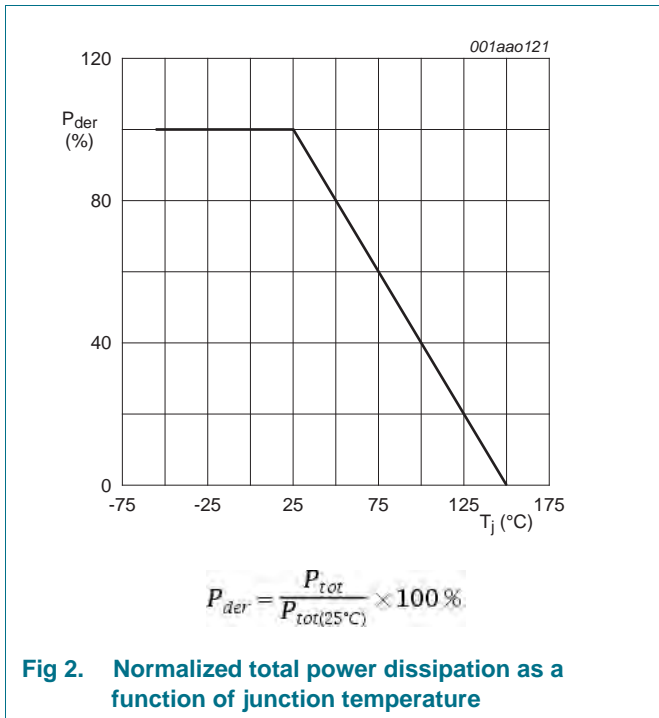
## 5. Limiting values

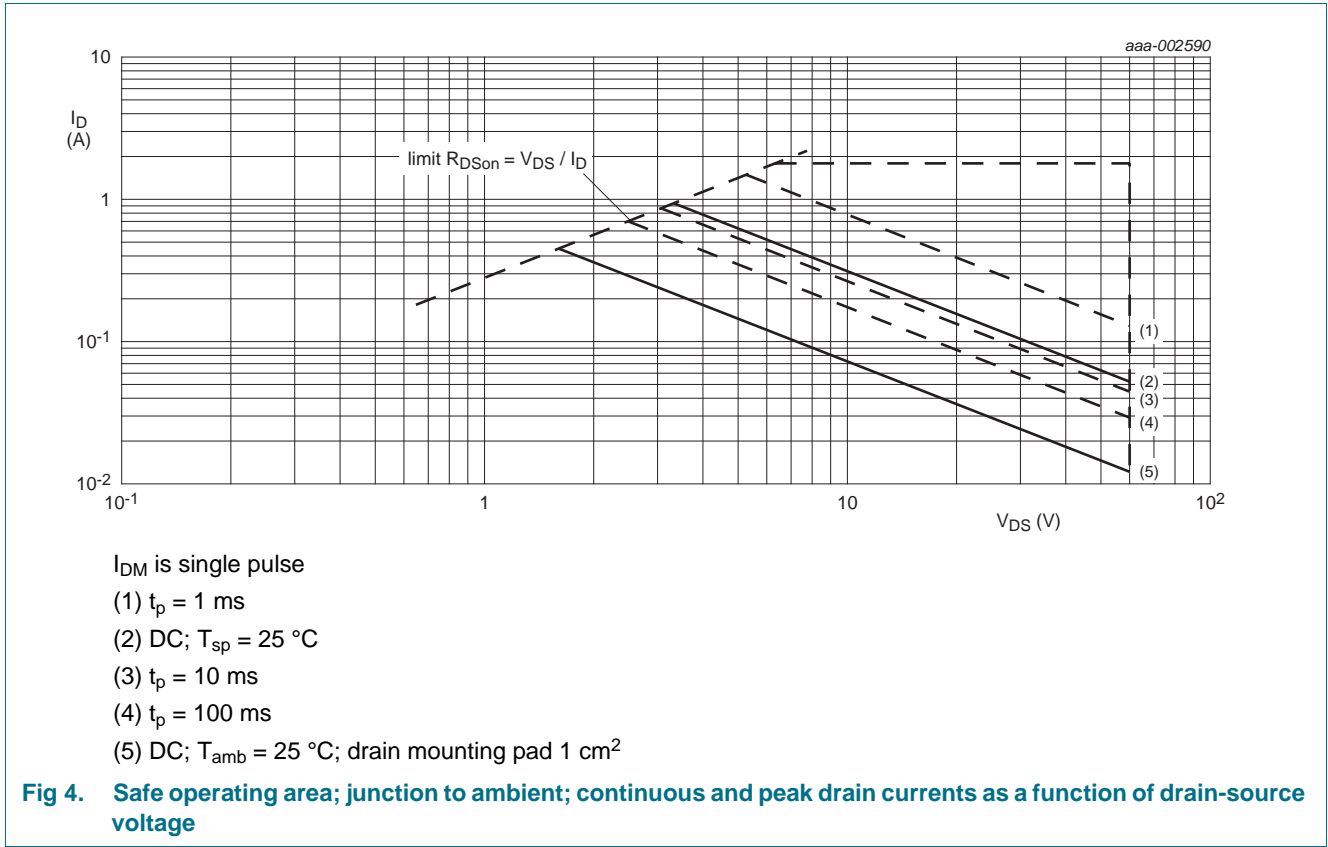
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit	
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> = 25 °C	-	60	V	
V <sub>GS</sub>	gate-source voltage		-20	20	V	
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>amb</sub> = 25 °C	[1]	-	450	mA
		V <sub>GS</sub> = 10 V; T <sub>amb</sub> = 100 °C	[1]	-	220	mA
I <sub>DM</sub>	peak drain current	T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs	-	1.8	A	
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = 25 °C	[2]	-	360	mW
			[1]	-	715	mW
		T <sub>sp</sub> = 25 °C		-	2700	mW
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	
<b>Source-drain diode</b>						
I <sub>S</sub>	source current	T <sub>amb</sub> = 25 °C	[1]	-	450	mA
<b>ESD maximum rating</b>						
V <sub>ESD</sub>	electrostatic discharge voltage	HBM	[3]	-	2000	V

- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 1 cm<sup>2</sup>.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [3] Measured between all pins.





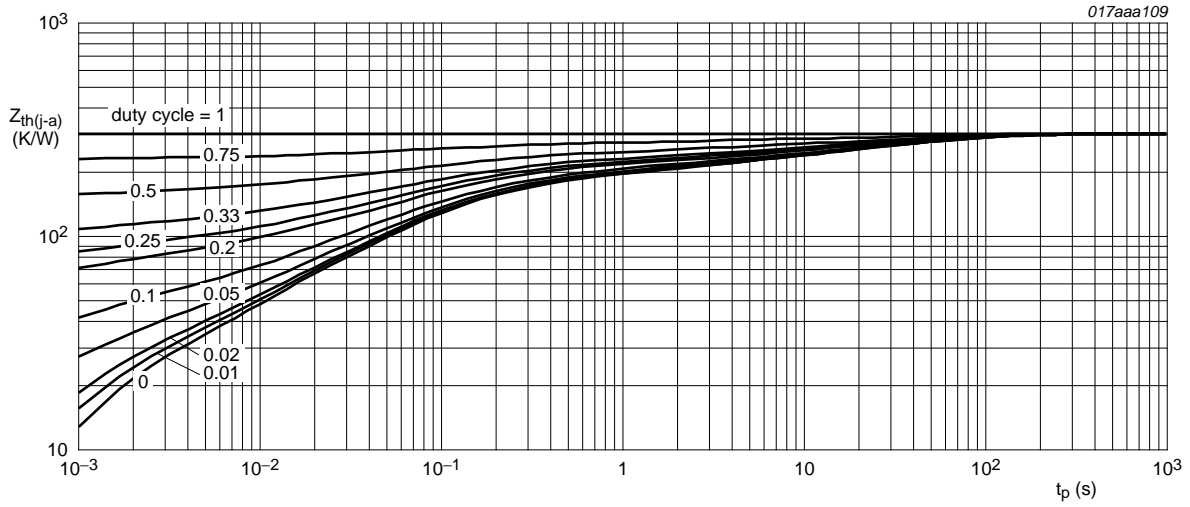
## 6. Thermal characteristics

**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]	-	305	350	K/W
			[2]	-	150	175	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	40	K/W	

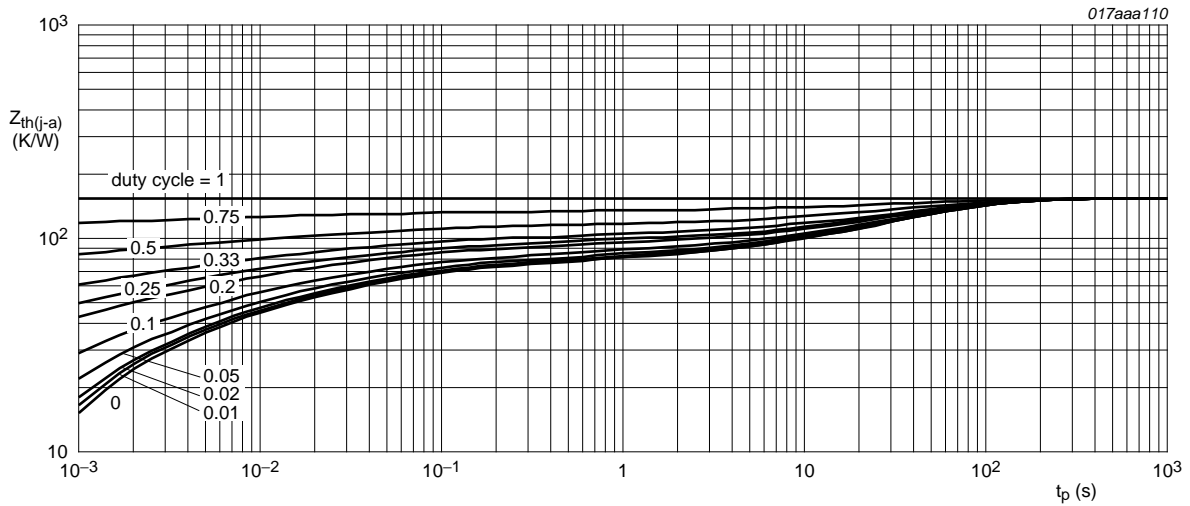
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

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



FR4 PCB, standard footprint

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



FR4 PCB, mounting pad for drain 1 cm<sup>2</sup>

Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 10 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	60	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ C$	1.1	1.6	2.1	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	1	$\mu A$
		$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 150 \text{ }^\circ C$	-	-	10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = -20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	10	$\mu A$
		$V_{GS} = 20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	10	$\mu A$
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 450 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	1	1.6	$\Omega$
		$V_{GS} = 10 V$ ; $I_D = 450 \text{ mA}$ ; $T_j = 150 \text{ }^\circ C$	-	2.2	3.5	$\Omega$
		$V_{GS} = 5 V$ ; $I_D = 50 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	1.3	2	$\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = 10 V$ ; $I_D = 200 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	550	-	mS
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 V$ ; $I_D = 300 \text{ mA}$ ; $V_{GS} = 4.5 V$ ; $T_j = 25 \text{ }^\circ C$	-	0.5	0.6	nC
$Q_{GS}$	gate-source charge		-	0.2	-	nC
$Q_{GD}$	gate-drain charge		-	0.1	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 10 V$ ; $f = 1 \text{ MHz}$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	33	50	pF
$C_{oss}$	output capacitance		-	7	-	pF
$C_{rss}$	reverse transfer capacitance		-	4	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 50 V$ ; $R_L = 250 \Omega$ ; $V_{GS} = 10 V$ ; $R_{G(ext)} = 6 \Omega$ ; $T_j = 25 \text{ }^\circ C$	-	5	10	ns
$t_r$	rise time		-	6	-	ns
$t_{d(off)}$	turn-off delay time		-	12	24	ns
$t_f$	fall time		-	7	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 115 \text{ mA}$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	0.47	0.75	1.1	V

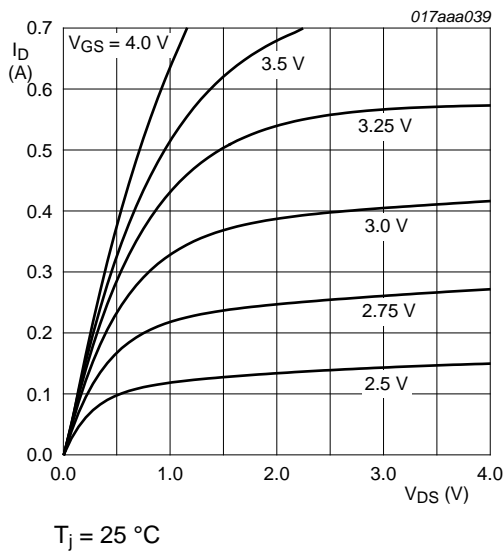


Fig 7. Output characteristics: drain current as a function of drain-source voltage; typical values

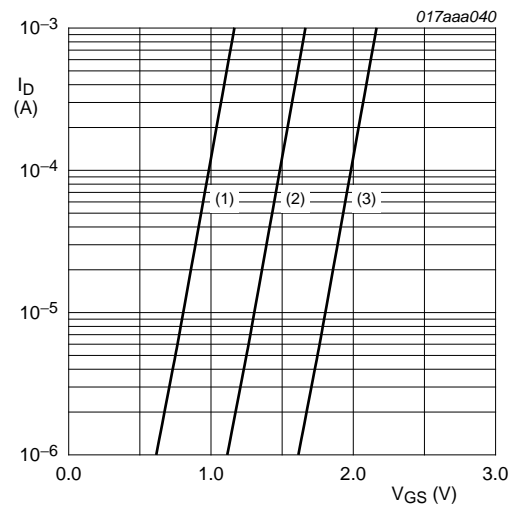
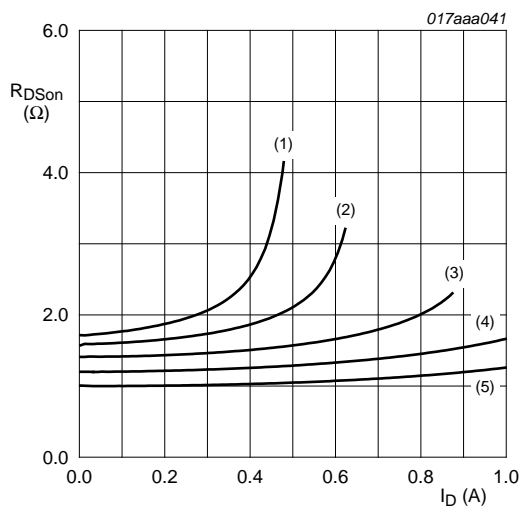
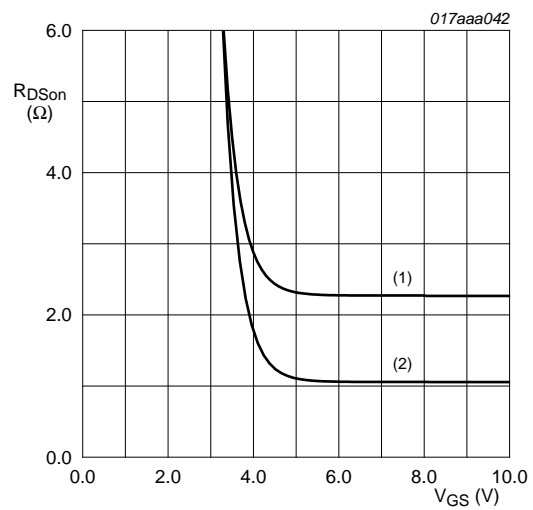


Fig 8. Sub-threshold drain current as a function of gate-source voltage



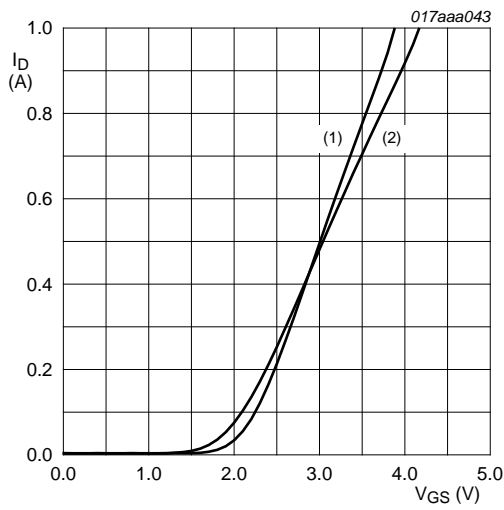
- (1)  $V_{GS} = 3.25\text{ V}$
- (2)  $V_{GS} = 3.5\text{ V}$
- (3)  $V_{GS} = 4\text{ V}$
- (4)  $V_{GS} = 5\text{ V}$
- (5)  $V_{GS} = 10\text{ V}$

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



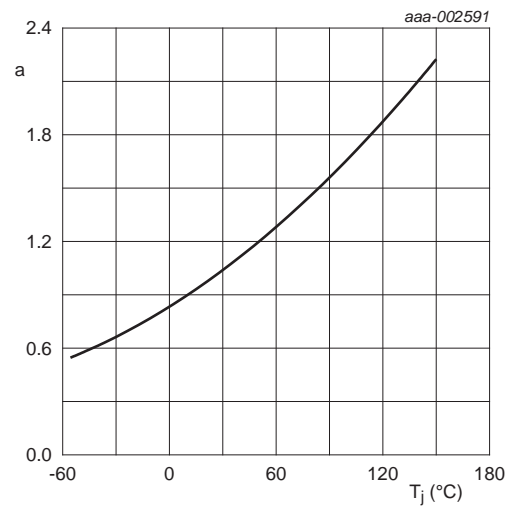
- (1)  $T_j = 150\text{ }^\circ\text{C}$
- (2)  $T_j = 25\text{ }^\circ\text{C}$

Fig 10. Drain-source on-state resistance as a function of gate-source voltage; typical values



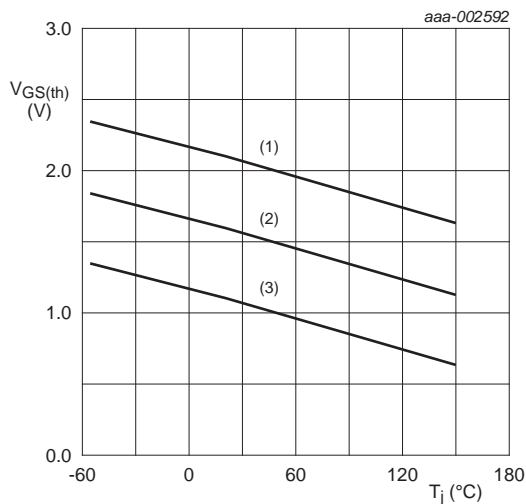
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25\text{ °C}$   
 (2)  $T_j = 150\text{ °C}$

**Fig 11. Transfer characteristics: drain current as a function of gate-source voltage; typical values**



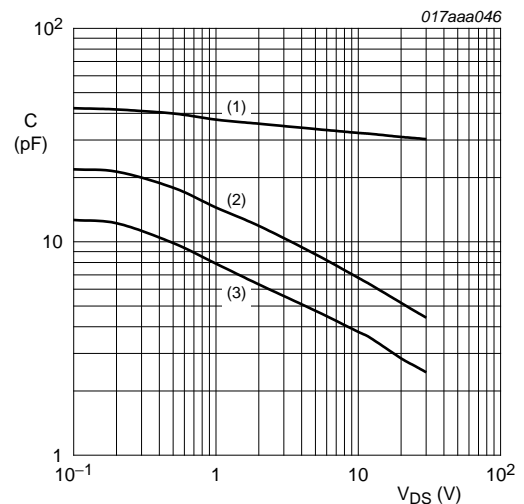
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25\text{°C})}}$$

**Fig 12. Normalized drain-source on-state resistance as a function of junction temperature; typical values**



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

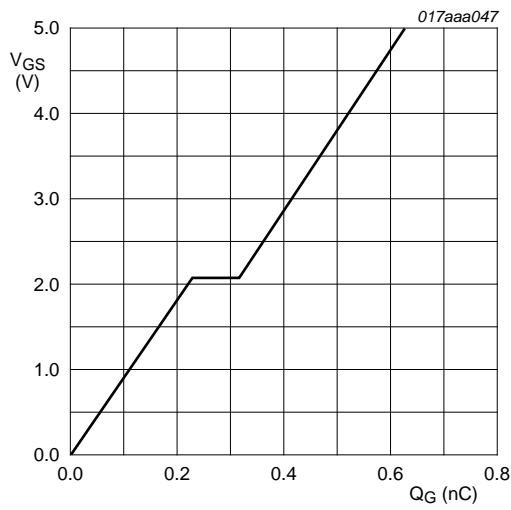
**Fig 13. Gate-source threshold voltage as a function of junction temperature**



$f = 1\text{ MHz}; V_{GS} = 0\text{ V}$   
 (1)  $C_{iss}$   
 (2)  $C_{oss}$   
 (3)  $C_{rss}$

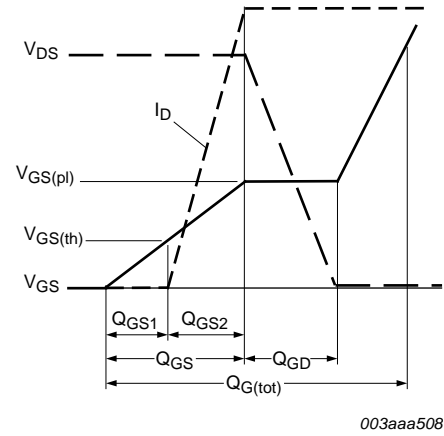
**Fig 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



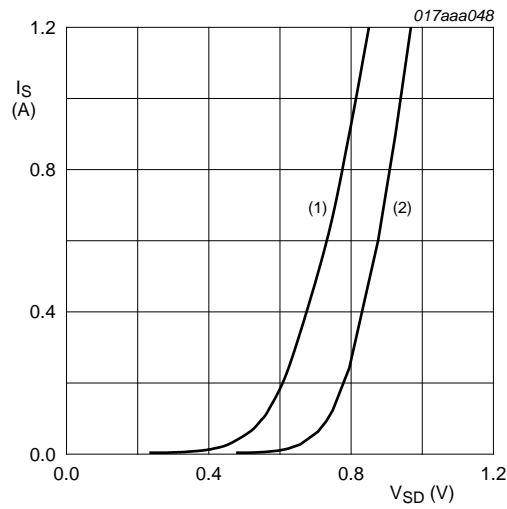


$I_D = 300 \text{ mA}; V_{DS} = 30 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$

**Fig 15. Gate-source voltage as a function of gate charge; typical values**



**Fig 16. Gate charge waveform definitions**



$V_{GS} = 0 \text{ V}$   
 (1)  $T_j = 150 \text{ }^\circ\text{C}$   
 (2)  $T_j = 25 \text{ }^\circ\text{C}$

**Fig 17. Source current as a function of source-drain voltage; typical values**

### 8. Test information



Fig 18. Duty cycle definition

### 9. Package outline

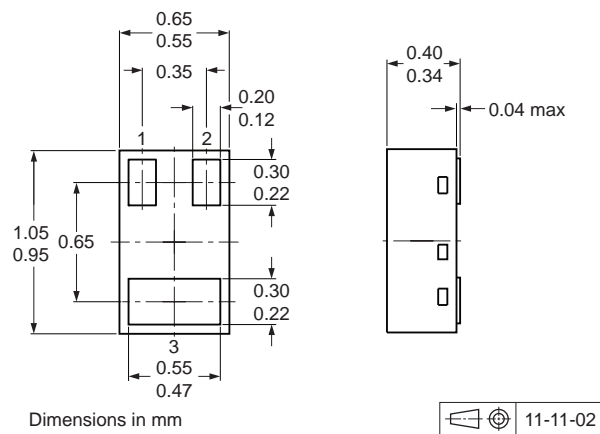


Fig 19. Package outline SOT883B (DFN1006B-3)



## 11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
2N7002BKMB v.2	20120613	Product data sheet	-	2N7002BKMB v.1
Modifications:	• <a href="#">7 "Characteristics"</a> : $R_{DS(on)}$ condition corrected			
2N7002BKMB v.1	20120511	Product data sheet	-	-

## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1]</sup> [2]	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.

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[2] The term 'short data sheet' is explained in section "Definitions".

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