



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

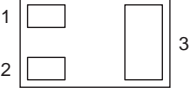
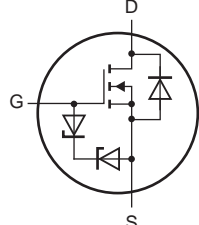
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j = 25\text{ °C}$	-	-	60	V
V_{GS}	gate-source voltage		-20	-	20	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	450	mA
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS}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

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 1 cm².



2. Pinning information

Table 2. Pinning information

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

3. Ordering information

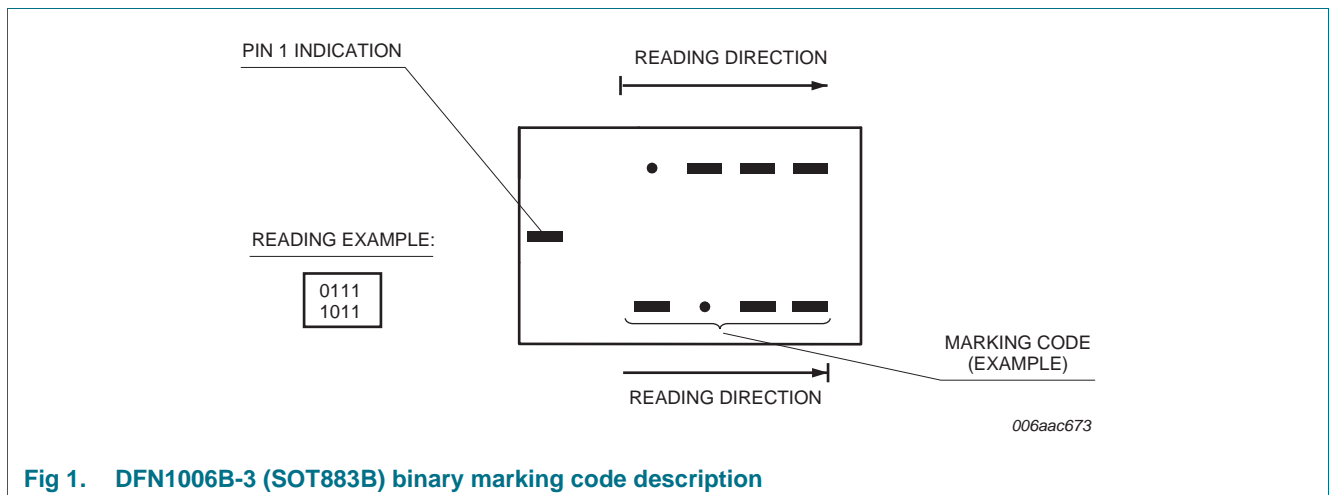
Table 3. Ordering information

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



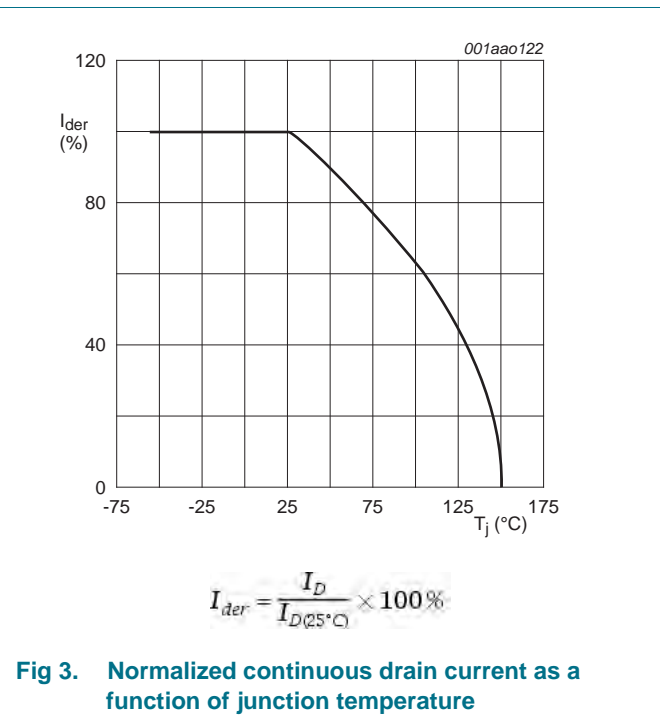
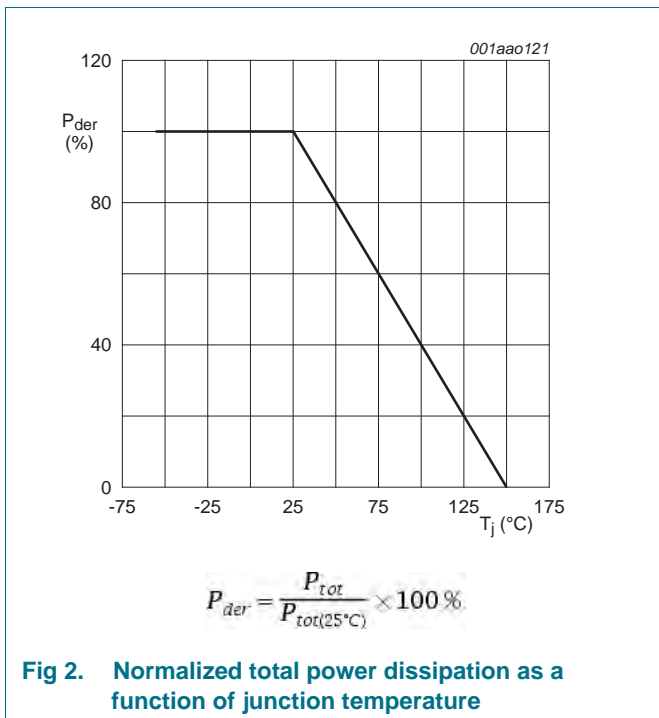
5. Limiting values

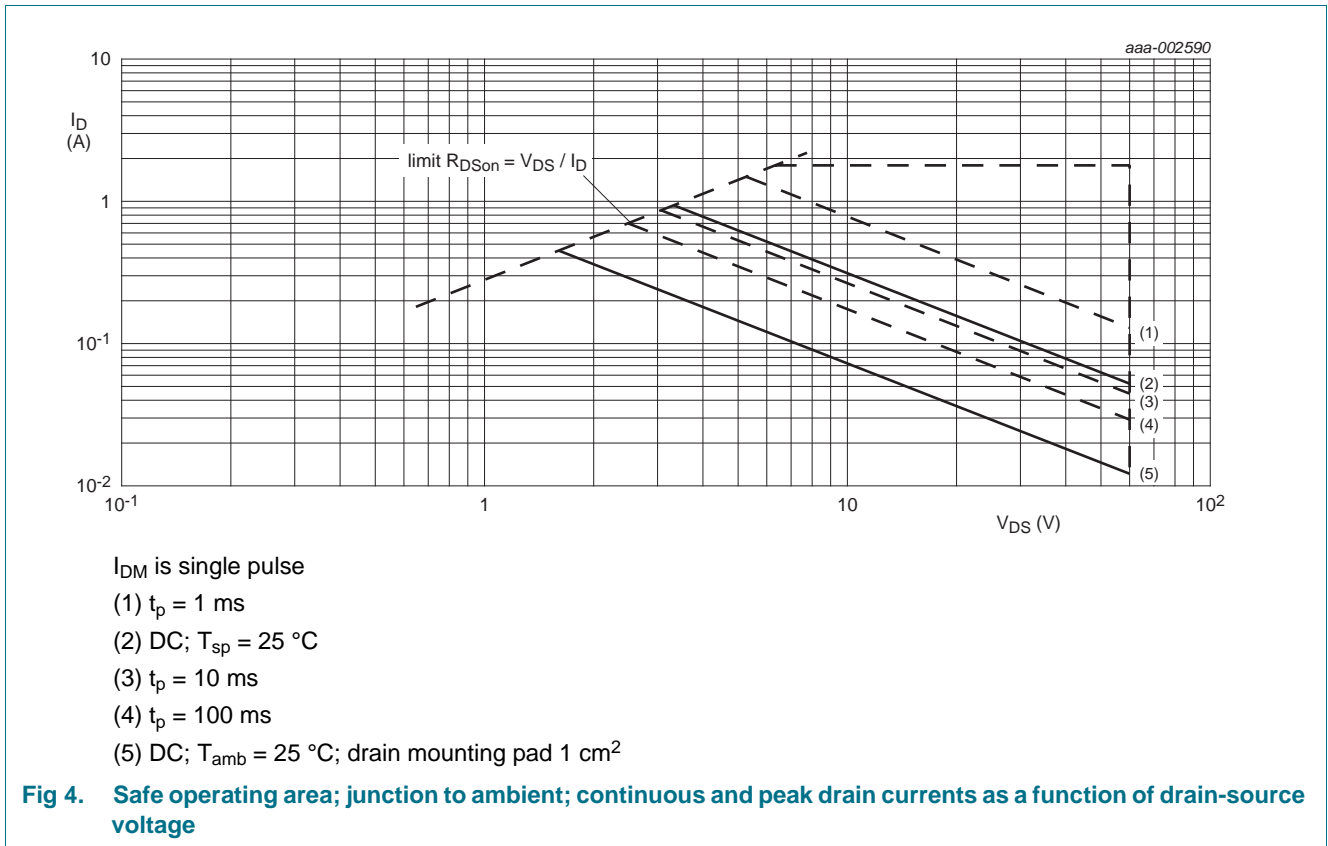
Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit	
V _{DS}	drain-source voltage	T _j = 25 °C	-	60	V	
V _{GS}	gate-source voltage		-20	20	V	
I _D	drain current	V _{GS} = 10 V; T _{amb} = 25 °C	[1]	-	450	mA
		V _{GS} = 10 V; T _{amb} = 100 °C	[1]	-	220	mA
I _{DM}	peak drain current	T _{amb} = 25 °C; single pulse; t _p ≤ 10 μs	-	1.8	A	
P _{tot}	total power dissipation	T _{amb} = 25 °C	[2]	-	360	mW
			[1]	-	715	mW
		T _{sp} = 25 °C		-	2700	mW
T _j	junction temperature		-55	150	°C	
T _{amb}	ambient temperature		-55	150	°C	
T _{stg}	storage temperature		-65	150	°C	
Source-drain diode						
I _S	source current	T _{amb} = 25 °C	[1]	-	450	mA
ESD maximum rating						
V _{ESD}	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 cm².
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [3] Measured between all pins.





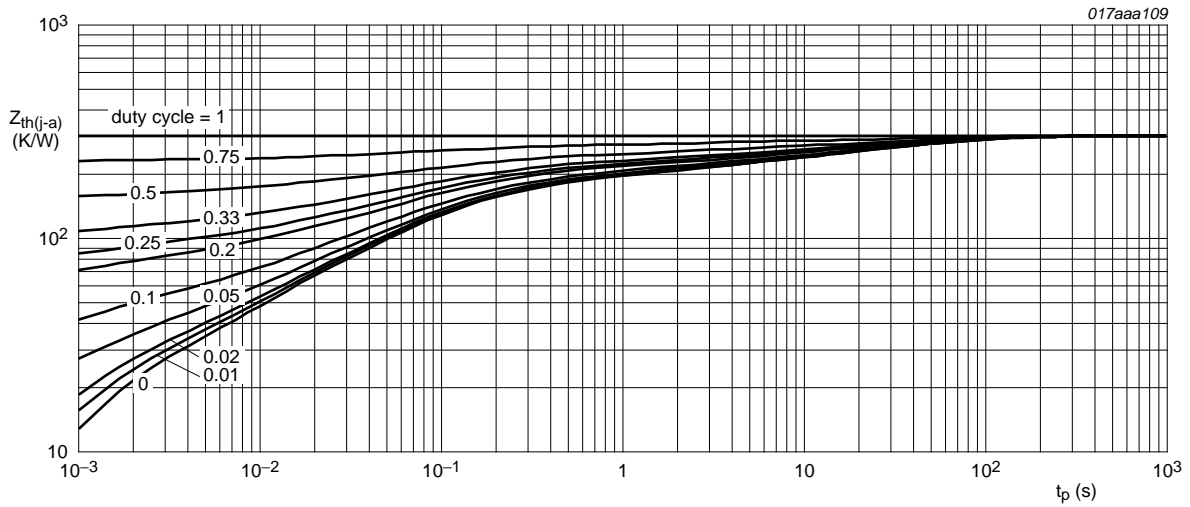
6. Thermal characteristics

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	

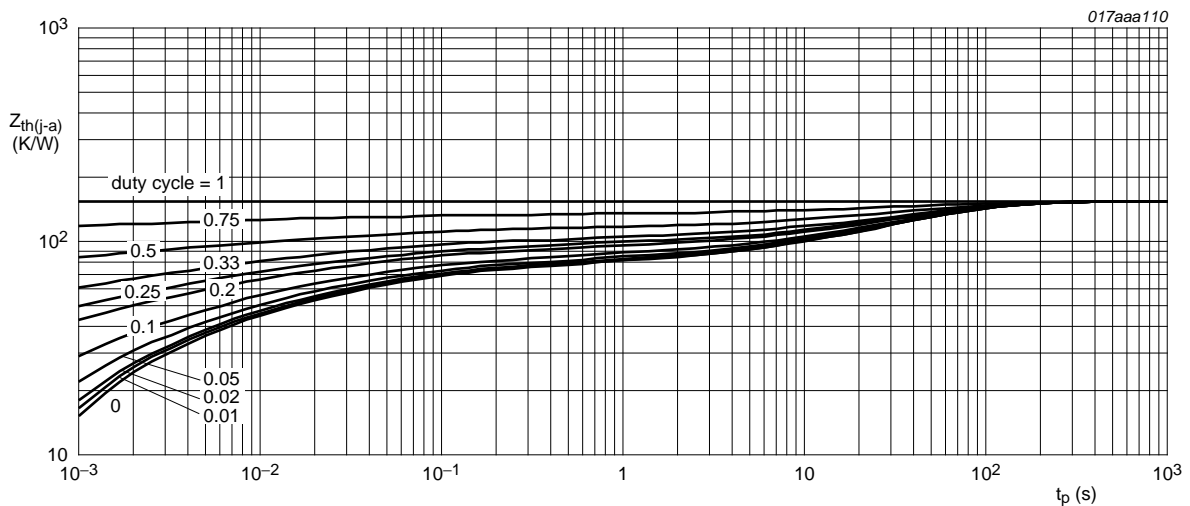
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².



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 cm²

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
Static characteristics						
$V_{(BR)DSS}$	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	μA
		$V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_j = 150 \text{ }^\circ C$	-	-	10	μA
I_{GSS}	gate leakage current	$V_{GS} = -20 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	-	10	μA
		$V_{GS} = 20 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	-	10	μA
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	Ω
		$V_{GS} = 10 V$; $I_D = 450 \text{ mA}$; $T_j = 150 \text{ }^\circ C$	-	2.2	3.5	Ω
		$V_{GS} = 5 V$; $I_D = 50 \text{ mA}$; $T_j = 25 \text{ }^\circ C$	-	1.3	2	Ω
g_{fs}	forward transconductance	$V_{DS} = 10 V$; $I_D = 200 \text{ mA}$; $T_j = 25 \text{ }^\circ C$	-	550	-	mS
Dynamic characteristics						
$Q_{G(tot)}$	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
Source-drain diode						
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

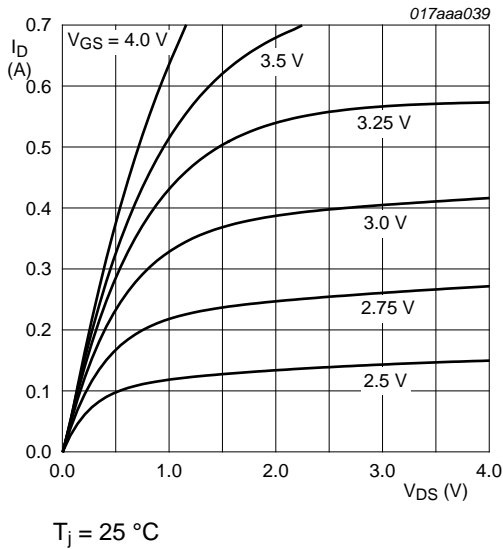


Fig 7. Output characteristics: drain current as a function of drain-source voltage; typical values

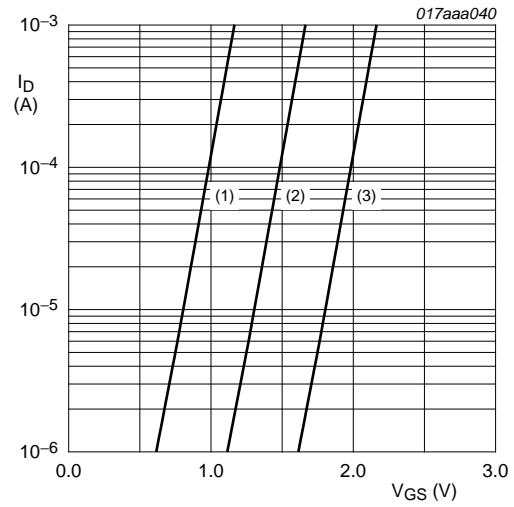
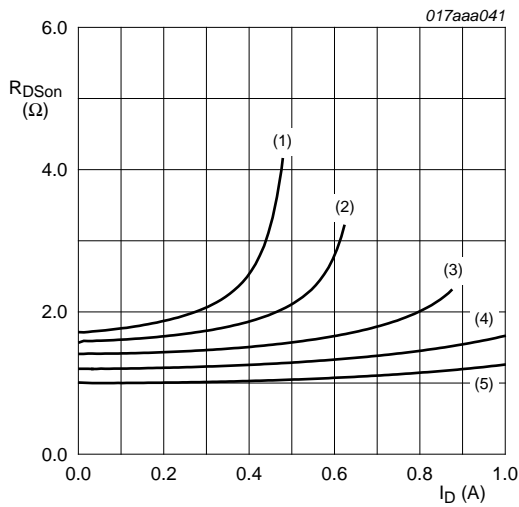
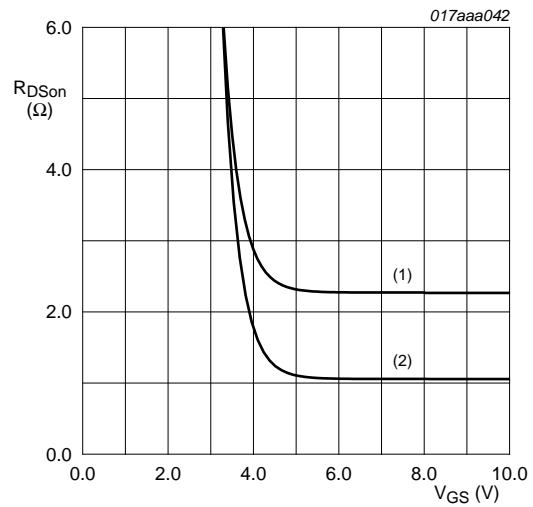


Fig 8. Sub-threshold drain current as a function of gate-source voltage



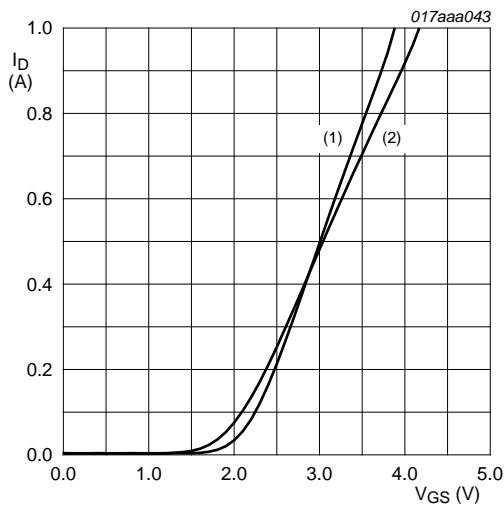
- (1) $V_{GS} = 3.25\text{ V}$
- (2) $V_{GS} = 3.5\text{ V}$
- (3) $V_{GS} = 4\text{ V}$
- (4) $V_{GS} = 5\text{ V}$
- (5) $V_{GS} = 10\text{ V}$

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



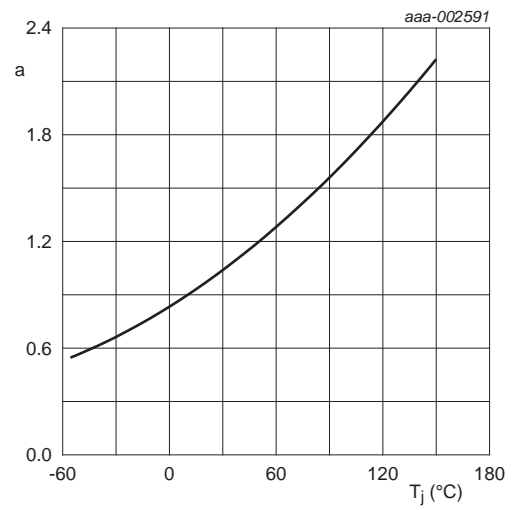
- (1) $T_j = 150\text{ }^\circ\text{C}$
- (2) $T_j = 25\text{ }^\circ\text{C}$

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



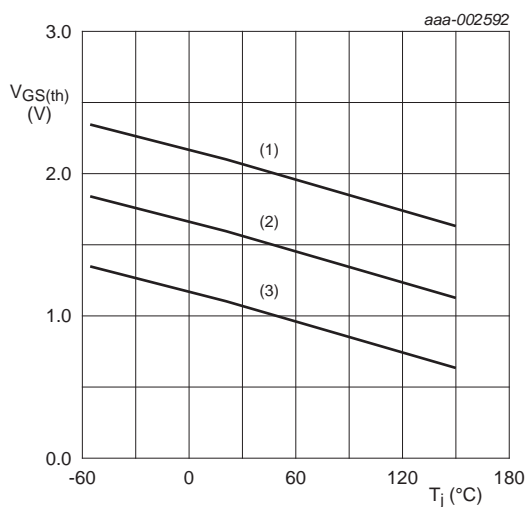
$V_{DS} > I_D \times R_{DS(on)}$
 (1) $T_j = 25\text{ °C}$
 (2) $T_j = 150\text{ °C}$

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



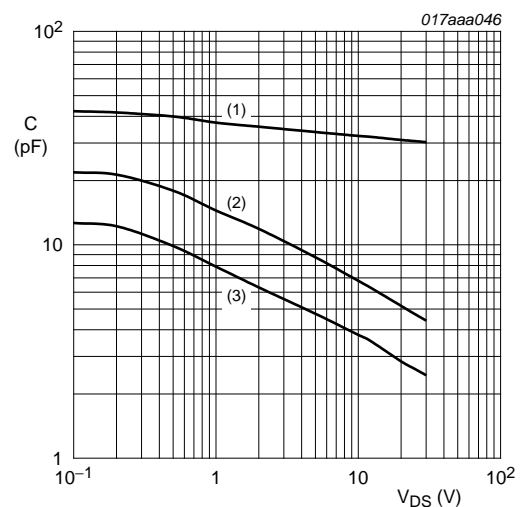
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25\text{ °C})}}$$

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



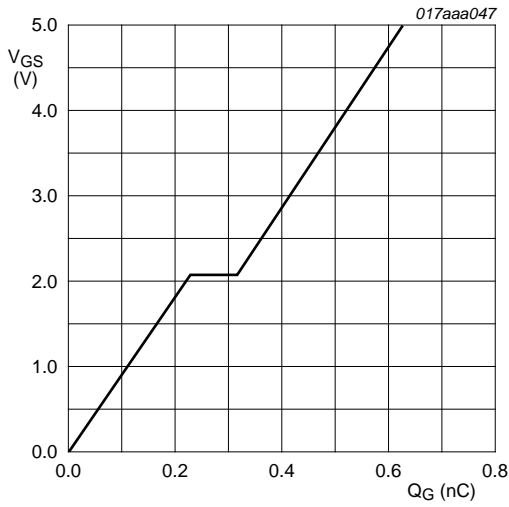
$I_D = 0.25\text{ A}; V_{DS} = V_{GS}$
 (1) maximum values
 (2) typical values
 (3) minimum values

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

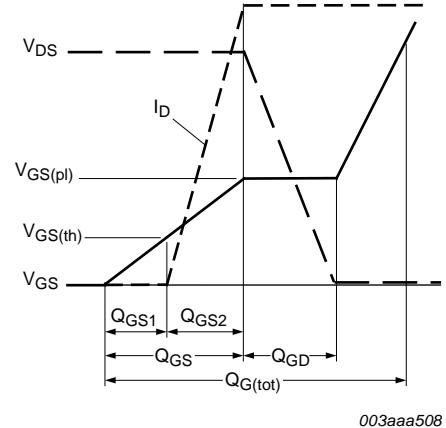
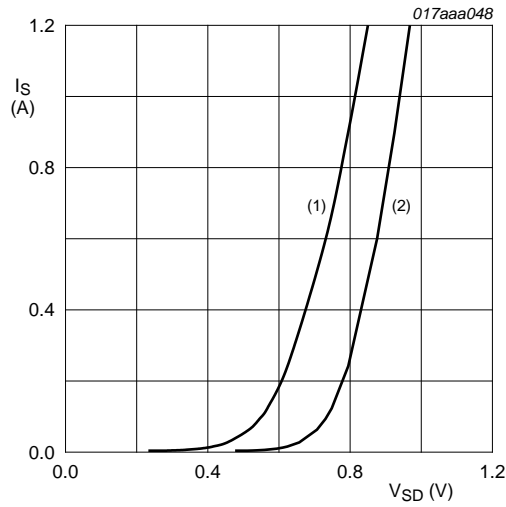


Fig 16. Gate charge waveform definitions



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

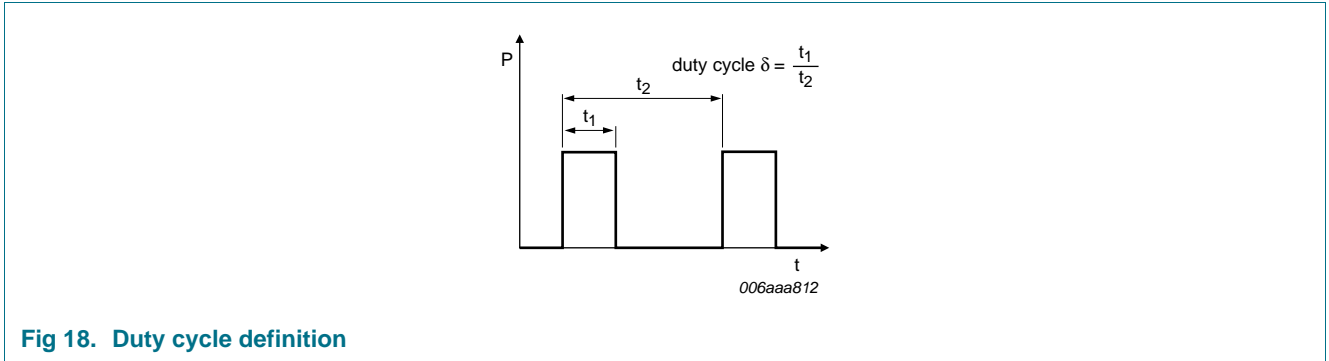


Fig 18. Duty cycle definition

9. Package outline

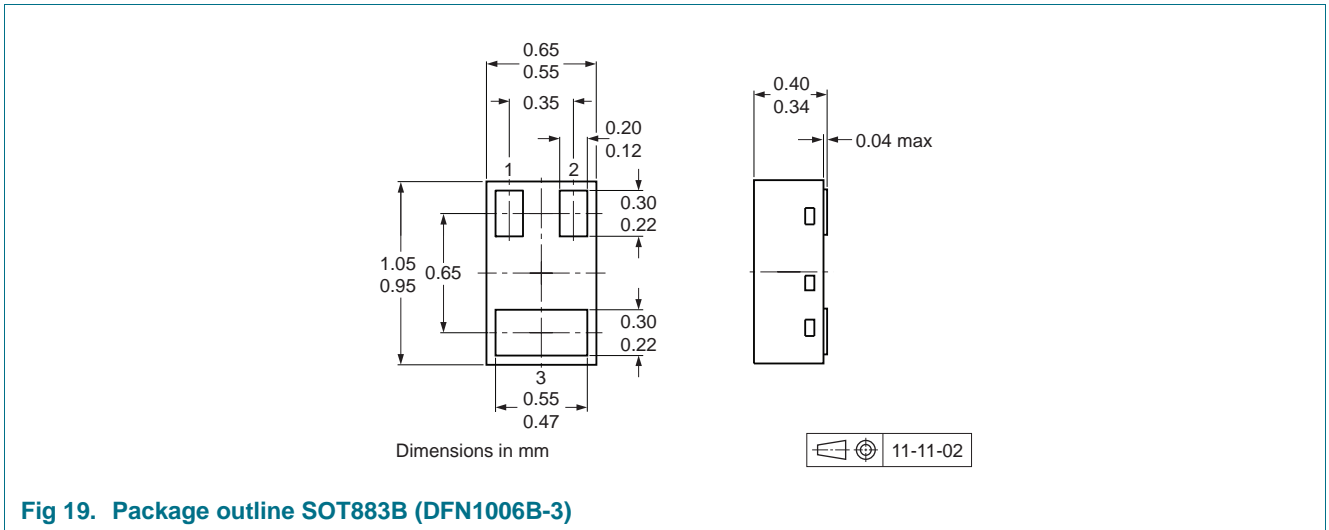
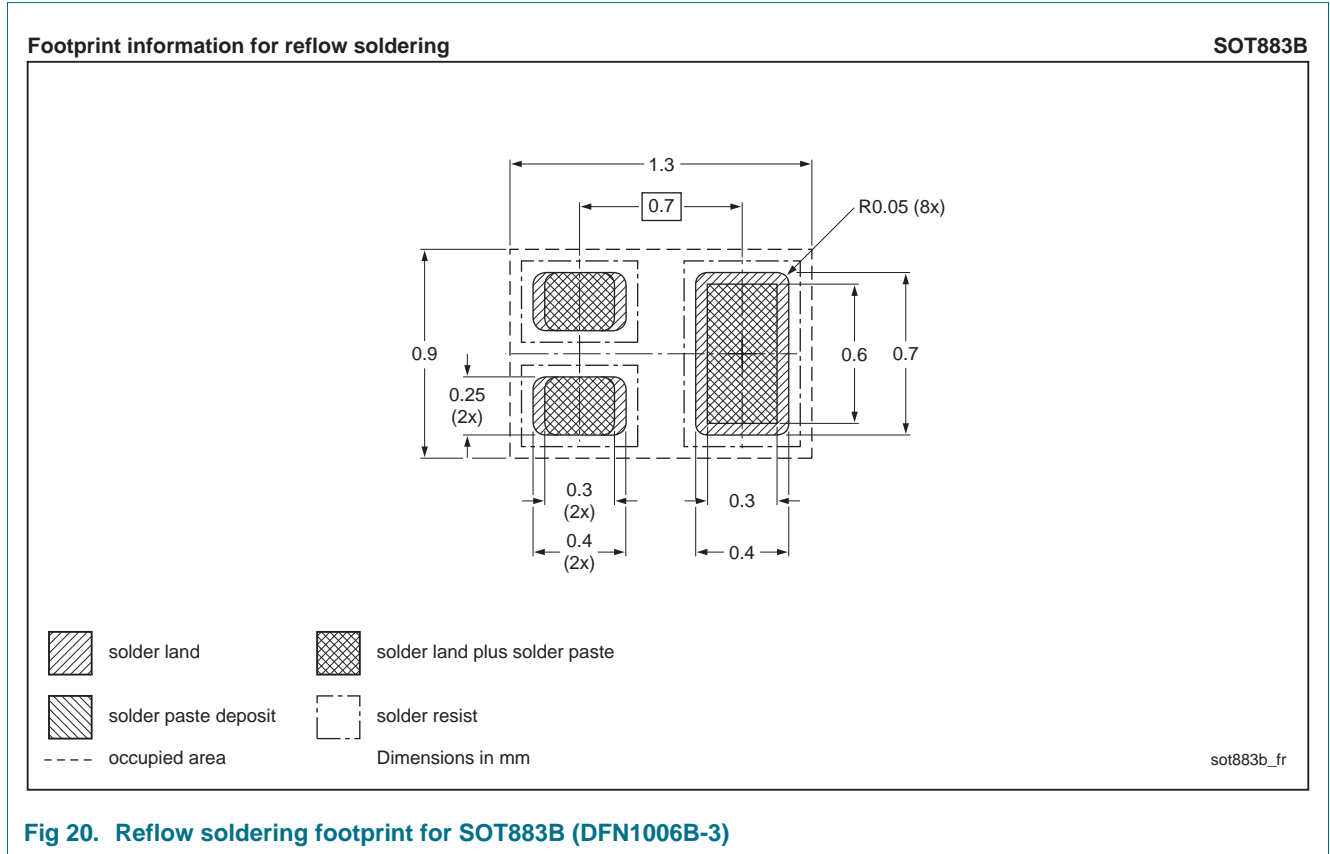


Fig 19. Package outline SOT883B (DFN1006B-3)

10. Soldering



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:	• 7 "Characteristics" : $R_{DS(on)}$ condition corrected			
2N7002BKMB v.1	20120511	Product data sheet	-	-

12. Legal information

12.1 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".

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