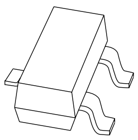


2N7002CK

60 V, 0.3 A N-channel Trench MOSFET

Rev. 01 — 11 September 2009 | Product data sheet

1. Product profile

1.1 General description

ESD protected N-channel enhancement mode Field-Effect Transistor (FET) in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

1.2 Features

- Logic-level compatible
- Very fast switching
- Trench MOSFET technology
- ESD protection up to 3 kV

1.3 Applications

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

1.4 Quick reference data

Table 1. Quick reference data

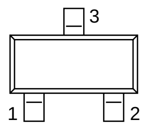
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage		-	-	60	V
I_D	drain current		-	-	300	mA
I_{DM}	peak drain current	single pulse; $t_p \leq 10$ µs	-	-	1.2	A
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA	-	1.1	1.6	Ω

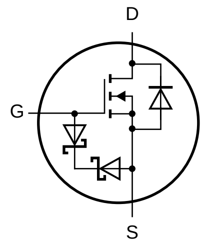
founded by Philips

2. Pinning information

Table 2. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	S	source		
3	D	drain		





017aaa000

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
2N7002CK	TO-236AB	plastic surface-mounted package; 3 leads	SOT23

4. Marking

Table 4. Marking codes

Type number	Marking code[1]
2N7002CK	LP*

[1] * = -: made in Hong Kong
* = p: made in Hong Kong
* = t: made in Malaysia
* = W: made in China

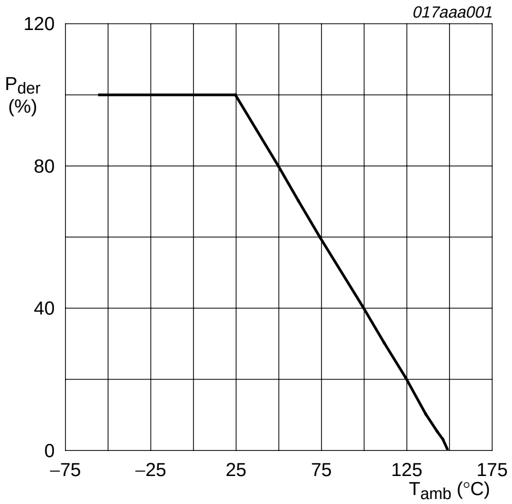
5. Limiting values

Table 5. Limiting values

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

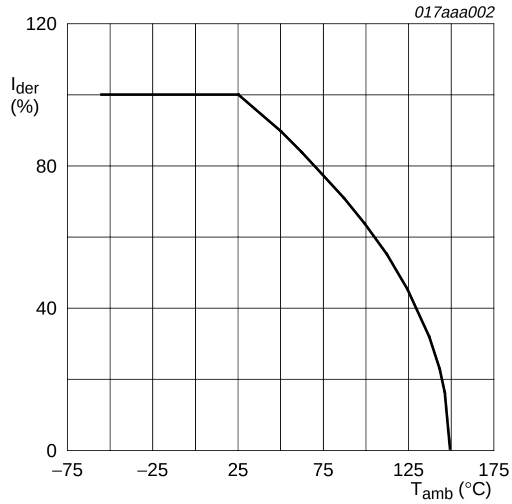
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 150 °C		-	60	V
V_{GS}	gate-source voltage			-	±20	V
I_D	drain current	V_{GS} = 10 V				
		T_{amb} = 25 °C		-	300	mA
		T_{amb} = 100 °C		-	190	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; t_p ≤ 10 µs		-	1.2	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[1]	-	350	mW
T_j	junction temperature				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		-	200	mA
I_{SM}	peak source current	T_{amb} = 25 °C; t_p ≤ 10 µs		-	1.2	A
ElectroStatic Discharge (ESD)						
V_{ESD}	electrostatic discharge voltage	all pins; human body model; C = 100 pF; R = 1.5 kΩ		-	3	kV

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



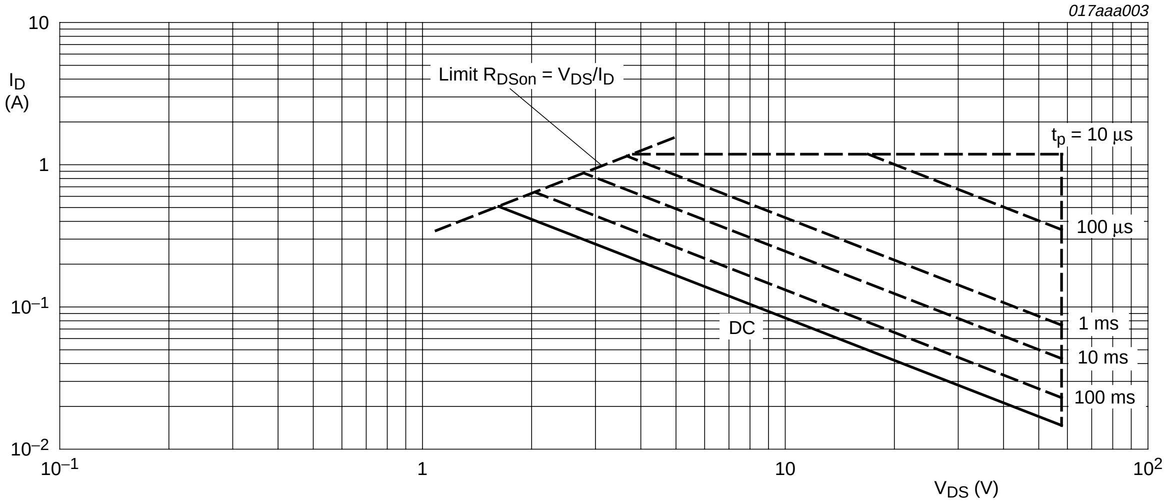
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\ \%$$

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



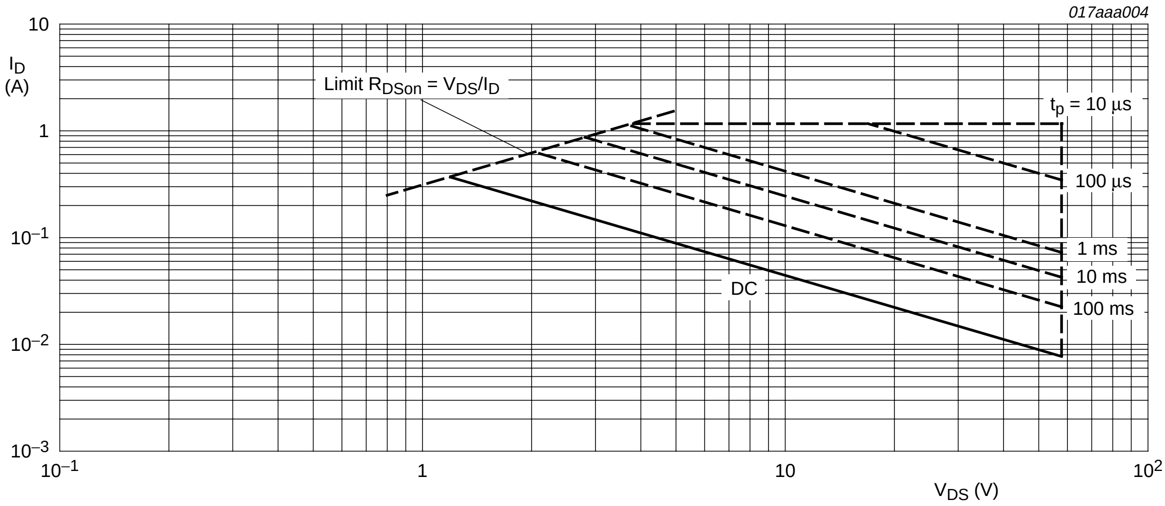
$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\ \%$$

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



T_{sp} = 25 °C; I_{DM} = single pulse; V_{GS} = 10 V

Fig 3. Safe operating area; junction to solder point; continuous and peak drain currents as a function of drain-source voltage



T_{amb} = 25 °C; I_{DM} = single pulse; V_{GS} = 10 V

Fig 4. Safe operating area; 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
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	350	500	K/W

Table 6. Thermal characteristics *...continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	150	K/W

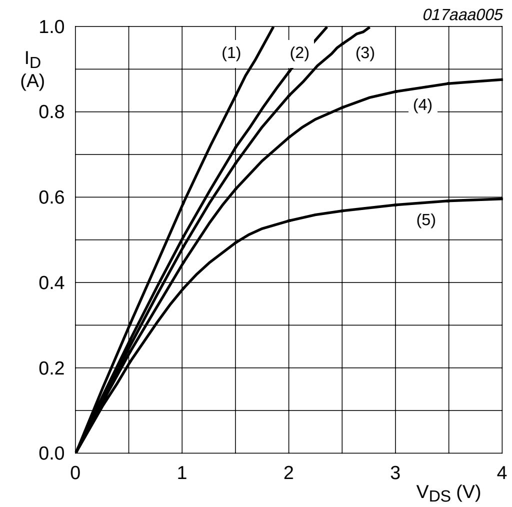
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

7. Characteristics

Table 7. Characteristics

T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 µA; V_{GS} = 0 V				
		T_j = 25 °C	60	-	-	V
		T_j = –55 °C	55	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 250 µA; V_{DS} = V_{GS}; T_j = 25 °C	1	1.75	2.5	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V				
		T_j = 25 °C	-	-	100	nA
		T_j = 150 °C	-	-	1	µA
I_{GSS}	gate leakage current	V_{GS} = ±20 V; V_{DS} = 0 V	-	-	5	µA
		V_{GS} = ±10 V; V_{DS} = 0 V	-	50	450	nA
		V_{GS} = ±5 V; V_{DS} = 0 V	-	-	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 4.5 V; I_D = 200 mA				
		T_j = 25 °C	-	1.3	3	Ω
		T_j = 150 °C	-	2.8	4.4	Ω
		V_{GS} = 10 V; I_D = 500 mA	-	1.1	1.6	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 200 mA; V_{DS} = 10 V; V_{GS} = 4.5 V	-	1.09	1.3	nC
Q_{GS}	gate-source charge		-	0.22	-	nC
Q_{GD}	gate-drain charge		-	0.23	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz	-	47.2	55	pF
C_{oss}	output capacitance		-	11	20	pF
C_{rss}	reverse transfer capacitance		-	5	7.5	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 15 V; R_L = 15 Ω; V_{GS} = 10 V; R_G = 6 Ω	-	8	15	ns
t_r	rise time		-	8	15	ns
$t_{d(off)}$	turn-off delay time		-	38	50	ns
t_f	fall time		-	22	35	ns
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 200 mA; V_{GS} = 0 V	0.47	0.79	1.1	V



T_j = 25 °C

(1) V_{GS} = 10 V

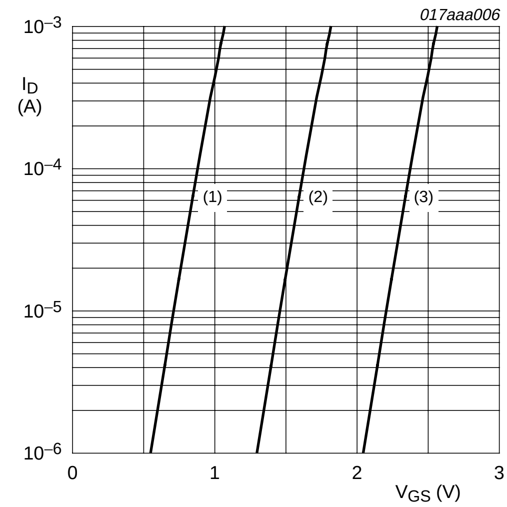
(2) V_{GS} = 5 V

(3) V_{GS} = 4.5 V

(4) V_{GS} = 4 V

(5) V_{GS} = 3.5 V

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



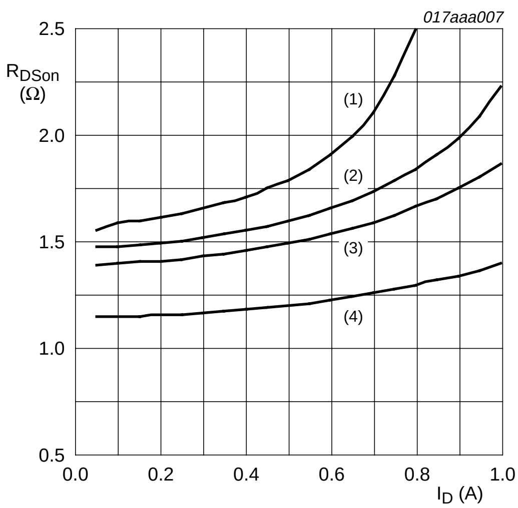
T_j = 25 °C; V_{DS} = 5 V

(1) minimum values

(2) typical values

(3) maximum values

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



T_j = 25 °C

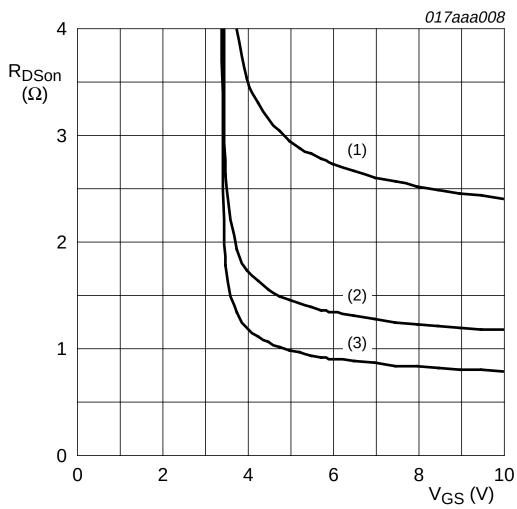
(1) V_{GS} = 4 V

(2) V_{GS} = 4.5 V

(3) V_{GS} = 5 V

(4) V_{GS} = 10 V

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



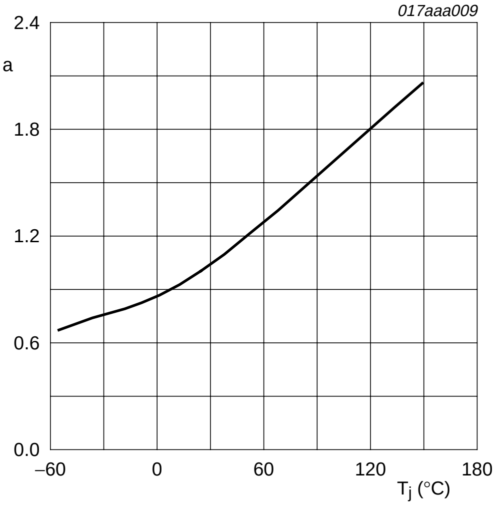
I_D = 500 mA

(1) T_j = 150 °C

(2) T_j = 25 °C

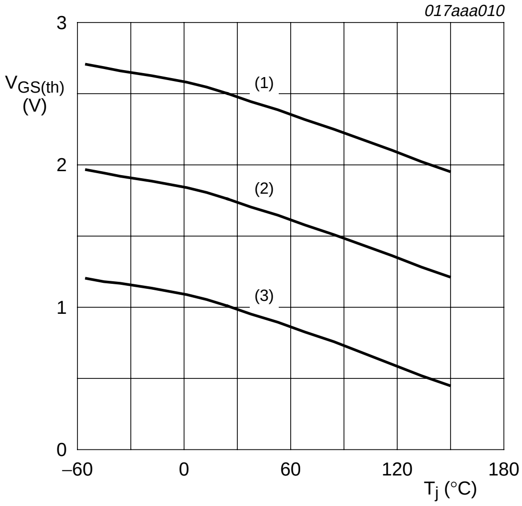
(3) T_j = −55 °C

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



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

Fig 9. Normalized drain-source on-state resistance factor as a function of junction temperature



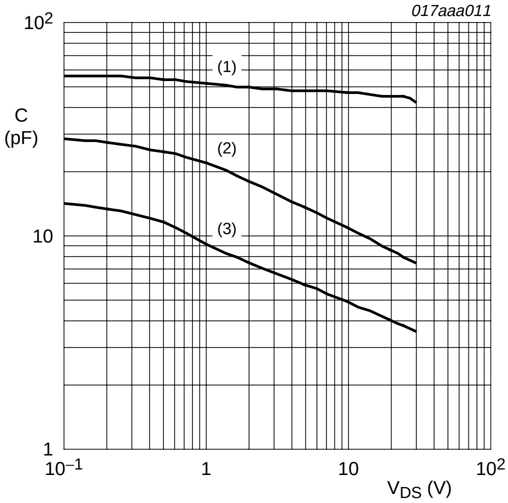
I_D = 0.25 mA; $V_{DS} = V_{GS}$

(1) maximum values

(2) typical values

(3) minimum values

Fig 10. Gate-source threshold voltage as a function of junction temperature



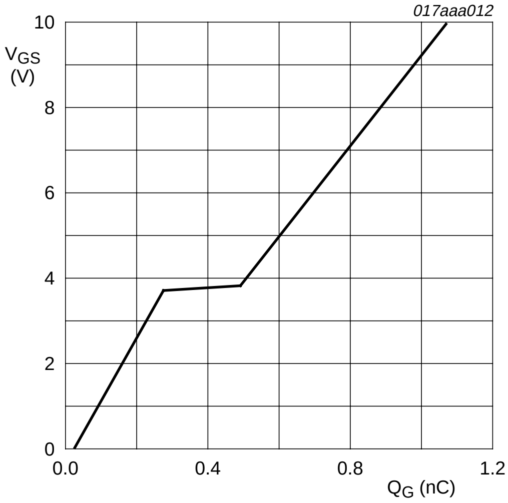
V_{GS} = 0 V; f = 1 MHz

(1) C_{iss}

(2) C_{oss}

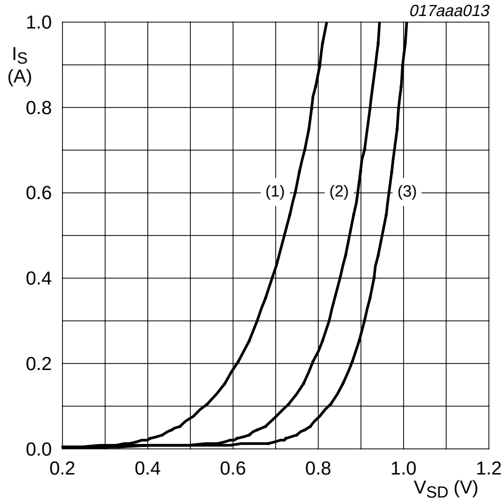
(3) C_{rss}

Fig 11. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



I_D = 200 mA; V_{DD} = 30 V; T_j = 25 °C

Fig 12. Gate-source voltage as a function of gate charge; typical values



V_{GS} = 0 V

(1) T_j = 150 °C

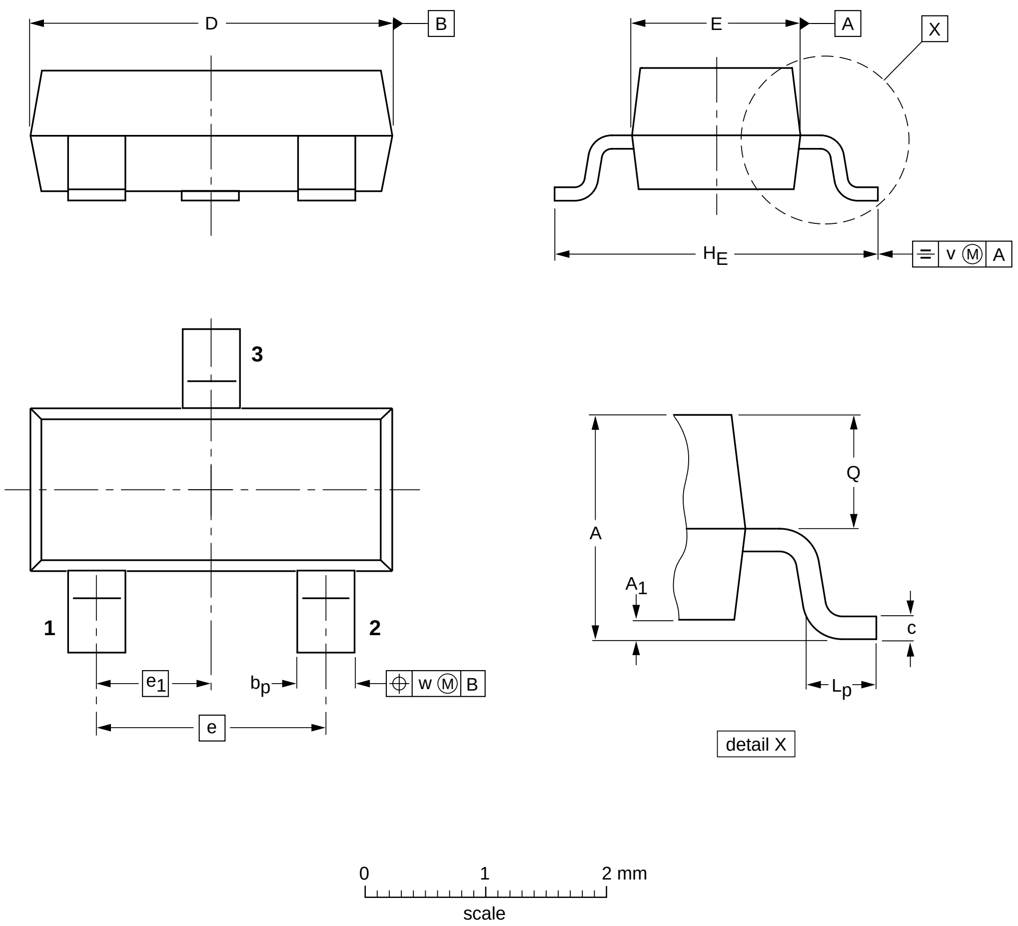
(2) T_j = 25 °C

(3) T_j = –55 °C

Fig 13. Source current as a function of source-drain voltage; typical values

8. Package outline

Plastic surface-mounted package; 3 leads **SOT23**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max.	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.1 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT23		TO-236AB				~~04-11-04~~ 06-03-16

Fig 14. Package outline SOT23 (TO-236AB)

9. Soldering

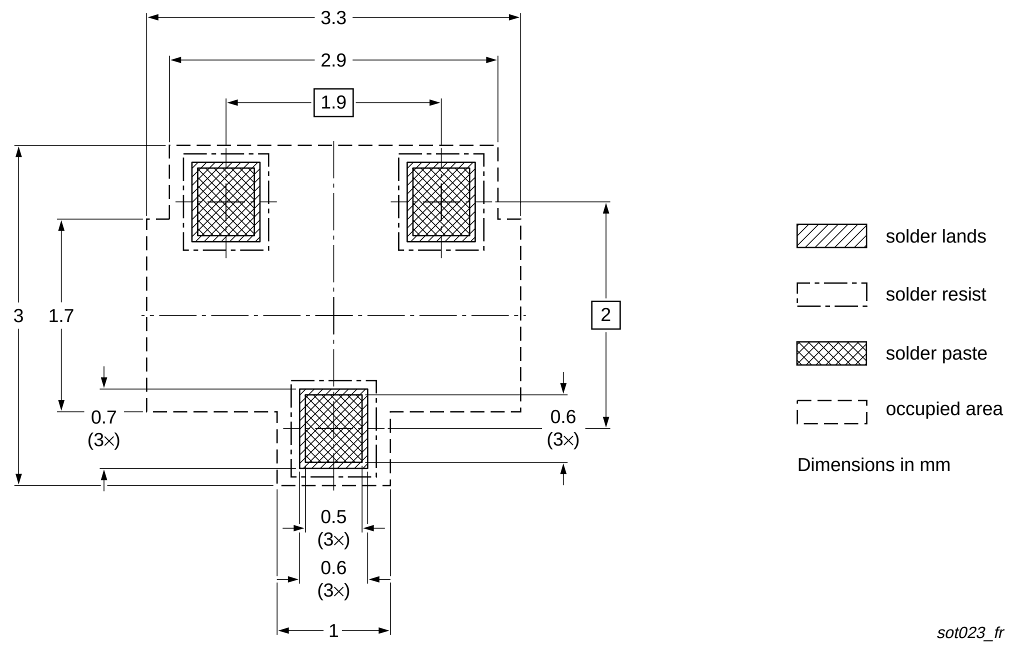


Fig 15. Reflow soldering footprint SOT23 (TO-236AB)

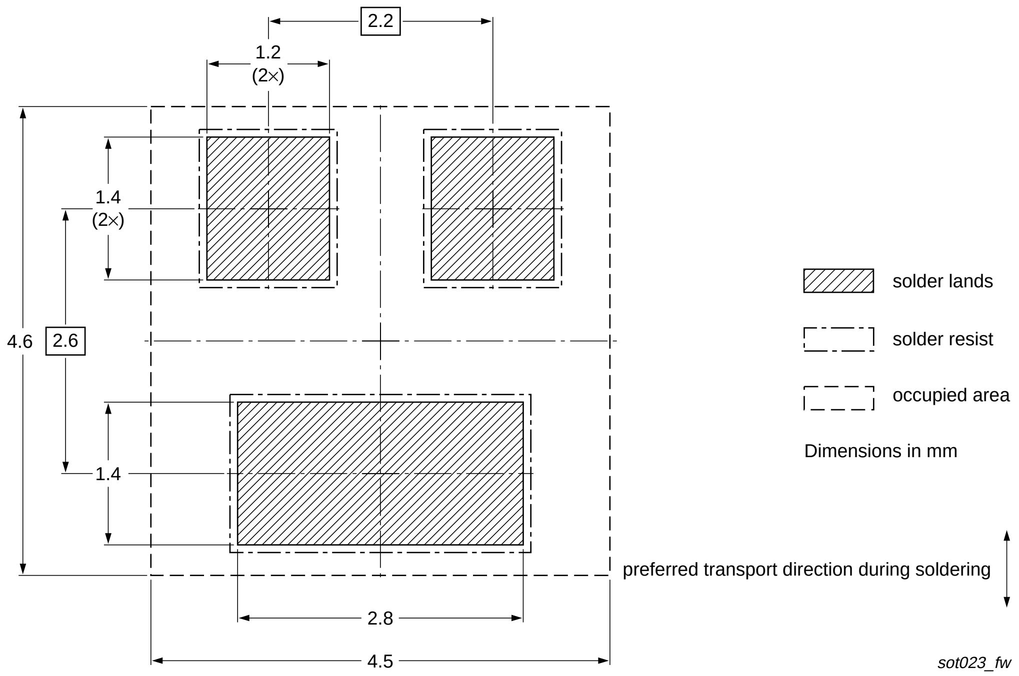


Fig 16. Wave soldering footprint SOT23 (TO-236AB)

10. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
2N7002CK_1	20090911	Product data sheet	-	-

11. Legal information

11.1 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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13. Contents

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