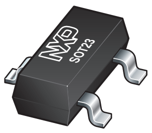


2N7002

60 V, 300 mA N-channel Trench MOSFET

Rev. 7 — 8 September 2011 | Product data sheet

1. Product profile

1.1 General description

N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using Trench MOSFET technology.

1.2 Features and benefits

- Suitable for logic level gate drive sources
- Very fast switching
- Surface-mounted package
- Trench MOSFET technology

1.3 Applications

- Logic level translators
- High-speed line drivers

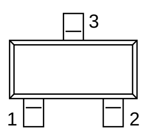
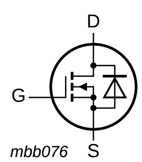
1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 150 °C	-	-	60	V
I_D	drain current	V_{GS} = 10 V; T_{sp} = 25 °C; see Figure 1; see Figure 3	-	-	300	mA
P_{tot}	total power dissipation	T_{sp} = 25 °C; see Figure 2	-	-	0.83	W
Static characteristics						
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA; T_j = 25 °C; see Figure 6; see Figure 8	-	2.8	5	Ω

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 SOT23 (TO-236AB)	
2	S	source		
3	D	drain		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
2N7002	TO-236AB	plastic surface-mounted package; 3 leads	SOT23

4. Marking

Table 4. Marking codes

Type number	Marking code[1]
2N7002	12%

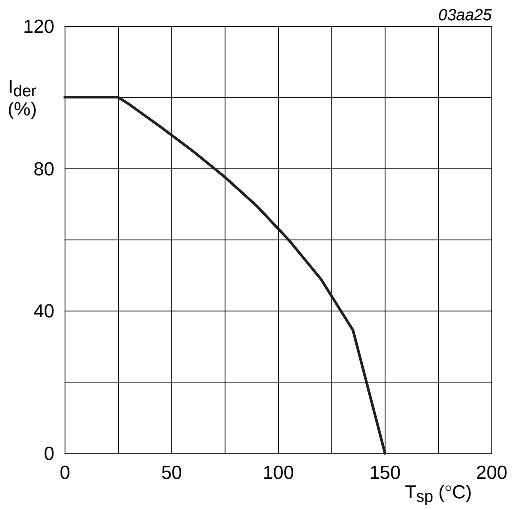
[1] % = placeholder for manufacturing site code

5. Limiting values

Table 5. Limiting values

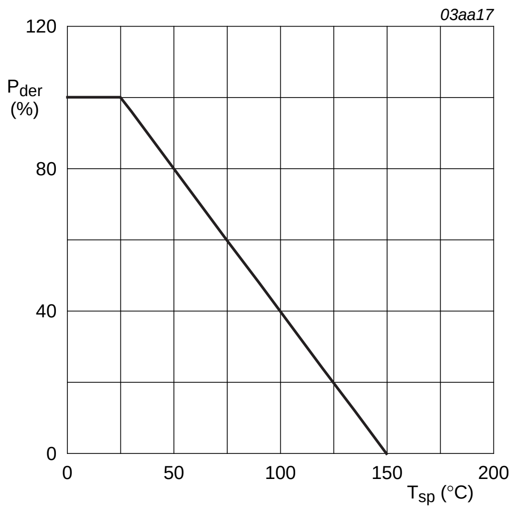
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 150 °C	-	60	V
V_{DGR}	drain-gate voltage	25 °C ≤ T_j ≤ 150 °C; R_{GS} = 20 kΩ	-	60	V
V_{GS}	gate-source voltage		-30	30	V
V_{GSM}	peak gate-source voltage	pulsed; t_p ≤ 50 µs; δ = 0.25	-40	40	V
I_D	drain current	V_{GS} = 10 V; T_{sp} = 25 °C; see Figure 1; see Figure 3	-	300	mA
		V_{GS} = 10 V; T_{sp} = 100 °C; see Figure 1	-	190	mA
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{sp} = 25 °C; see Figure 3	-	1.2	A
P_{tot}	total power dissipation	T_{sp} = 25 °C; see Figure 2	-	0.83	W
T_j	junction temperature		-65	150	°C
T_{stg}	storage temperature		-65	150	°C
Source-drain diode					
I_S	source current	T_{sp} = 25 °C	-	300	mA
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{sp} = 25 °C	-	1.2	A



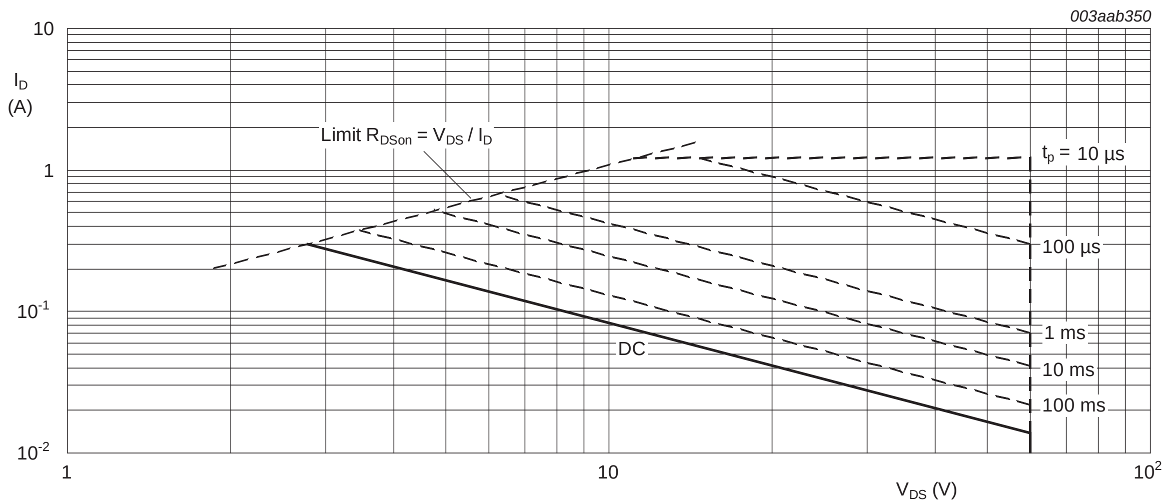
$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\,\%$$

Fig 1. Normalized continuous drain current as a function of solder point temperature



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

Fig 2. Normalized total power dissipation as a function of solder point temperature



$$T_{sp} = 25\,°C; I_{DM} \text{ is single pulse}$$

Fig 3. Safe operating area; continous 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	Mounted on a printed-circuit board; minimum footprint ; vertical in still air	-	-	350	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point	see Figure 4	-	-	150	K/W

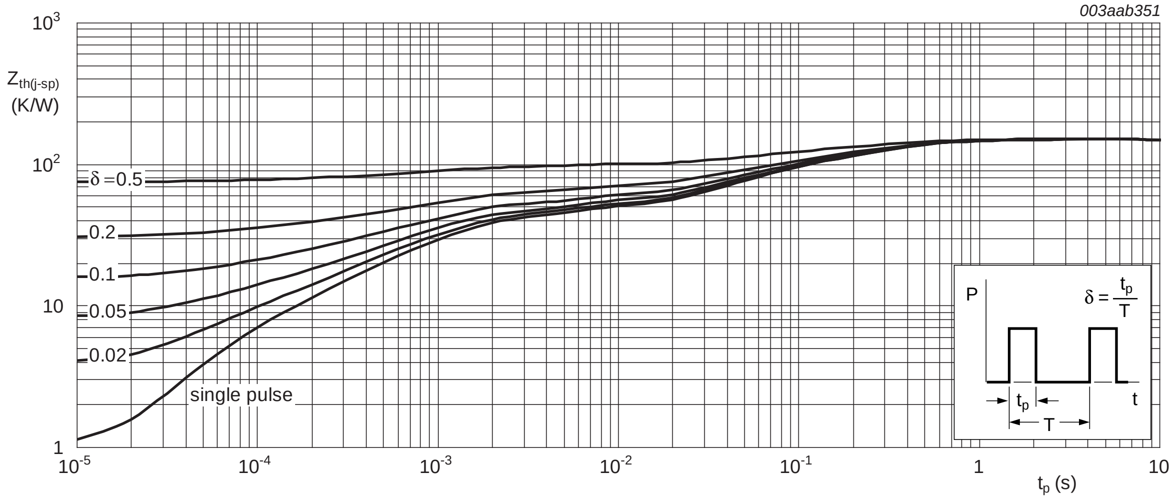
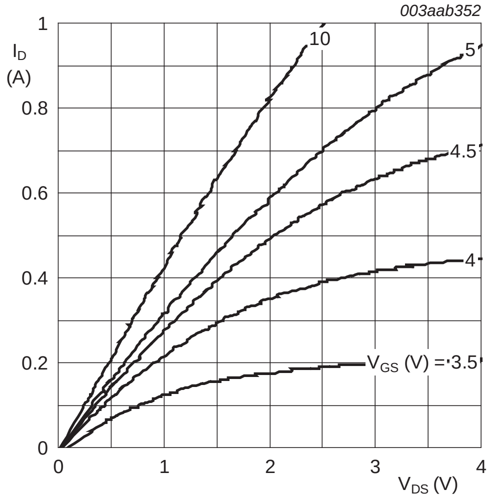


Fig 4. Transient thermal impedance from junction to solder point as a function of pulse duration

7. Characteristics

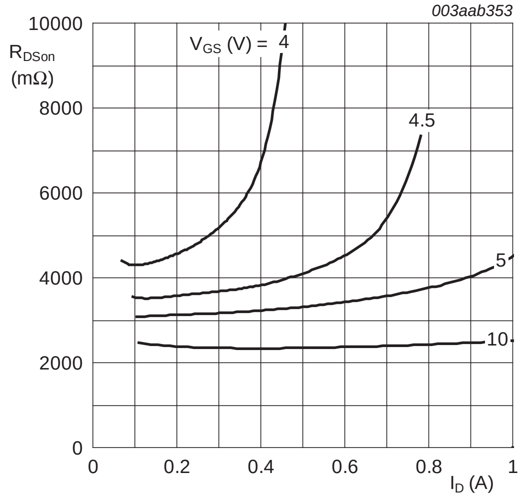
Table 7. Characteristics

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
		I_D = 10 µA; V_{GS} = 0 V; T_j = -55 °C	55	-	-	V
V_{GSth}	gate-source threshold voltage	I_D = 0.25 mA; V_{DS} = V_{GS}; T_j = 25 °C; see Figure 9; see Figure 10	1	2	2.5	V
		I_D = 0.25 mA; V_{DS} = V_{GS}; T_j = 150 °C; see Figure 9; see Figure 10	0.6	-	-	V
		I_D = 0.25 mA; V_{DS} = V_{GS}; T_j = -55 °C; see Figure 9; see Figure 10	-	-	2.75	V
I_{DSS}	drain leakage current	V_{DS} = 48 V; V_{GS} = 0 V; T_j = 25 °C	-	0.01	1	µA
		V_{DS} = 48 V; V_{GS} = 0 V; T_j = 150 °C	-	-	10	µA
I_{GSS}	gate leakage current	V_{GS} = 15 V; V_{DS} = 0 V; T_j = 25 °C	-	10	100	nA
		V_{GS} = -15 V; V_{DS} = 0 V; T_j = 25 °C	-	10	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA; T_j = 25 °C; see Figure 6; see Figure 8	-	2.8	5	Ω
		V_{GS} = 10 V; I_D = 500 mA; T_j = 150 °C; see Figure 6; see Figure 8	-	-	9.25	Ω
		V_{GS} = 4.5 V; I_D = 75 mA; T_j = 25 °C; see Figure 6; see Figure 8	-	3.8	5.3	Ω
Dynamic characteristics						
C_{iss}	input capacitance	V_{DS} = 10 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °C	-	31	50	pF
C_{oss}	output capacitance		-	6.8	30	pF
C_{rss}	reverse transfer capacitance		-	3.5	10	pF
t_{on}	turn-on time	V_{GS} = 10 V; V_{DS} = 50 V; R_L = 250 Ω; $R_{G(ext)}$ = 50 Ω; R_{GS} = 50 Ω	-	2.5	10	ns
t_{off}	turn-off time		-	11	15	ns
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 300 mA; V_{GS} = 0 V; T_j = 25 °C; see Figure 11	-	0.85	1.5	V
Q_r	recovered charge	V_{GS} = 0 V; I_S = 300 mA; dI_S/dt = -100 A/µs	-	30	-	nC
t_{rr}	reverse recovery time		-	30	-	ns



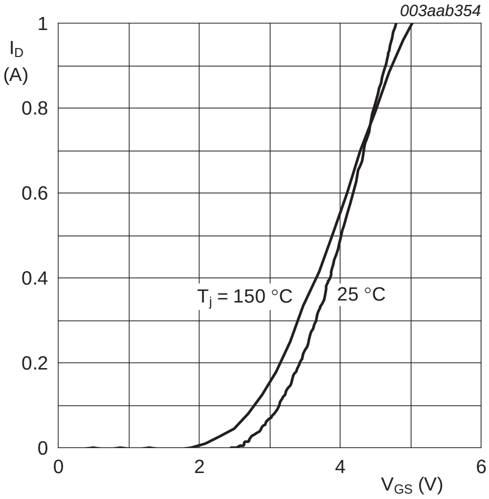
$T_j = 25°C$

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



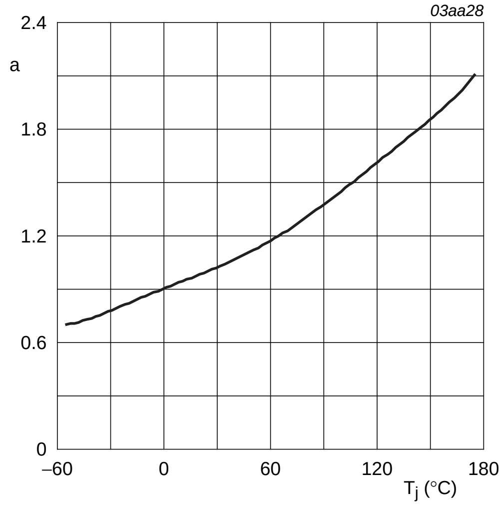
$T_j = 25°C$

Fig 6. Drain-source on-state resistance as a function of drain current; typical values



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

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



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

Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature

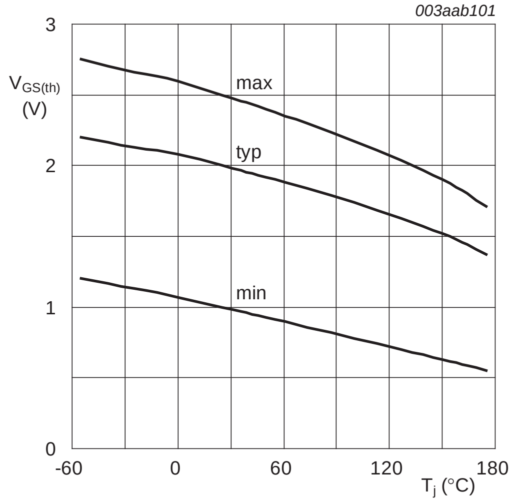


Fig 9. Gate-source threshold voltage as a function of junction temperature

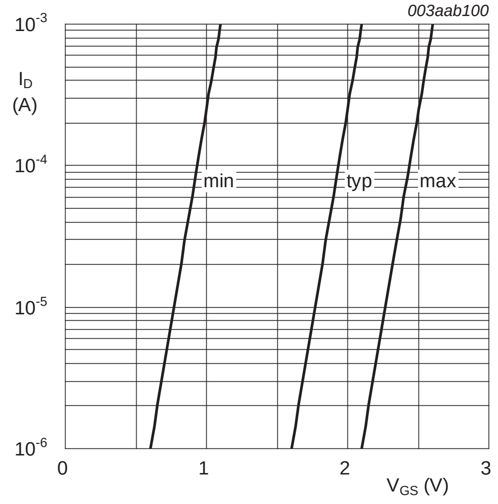
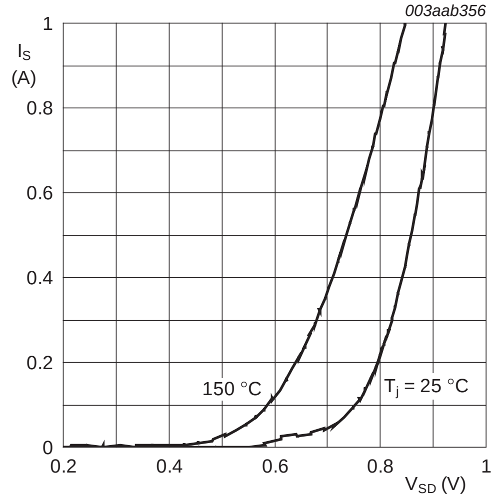
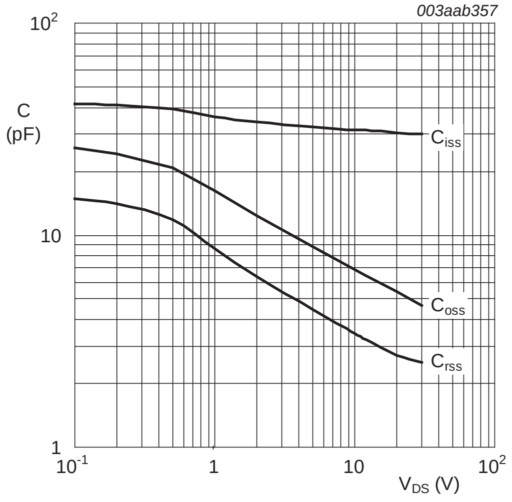


Fig 10. Sub-threshold drain current as a function of gate-source voltage



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

Fig 11. Source current as a function of source-drain voltage; typical values

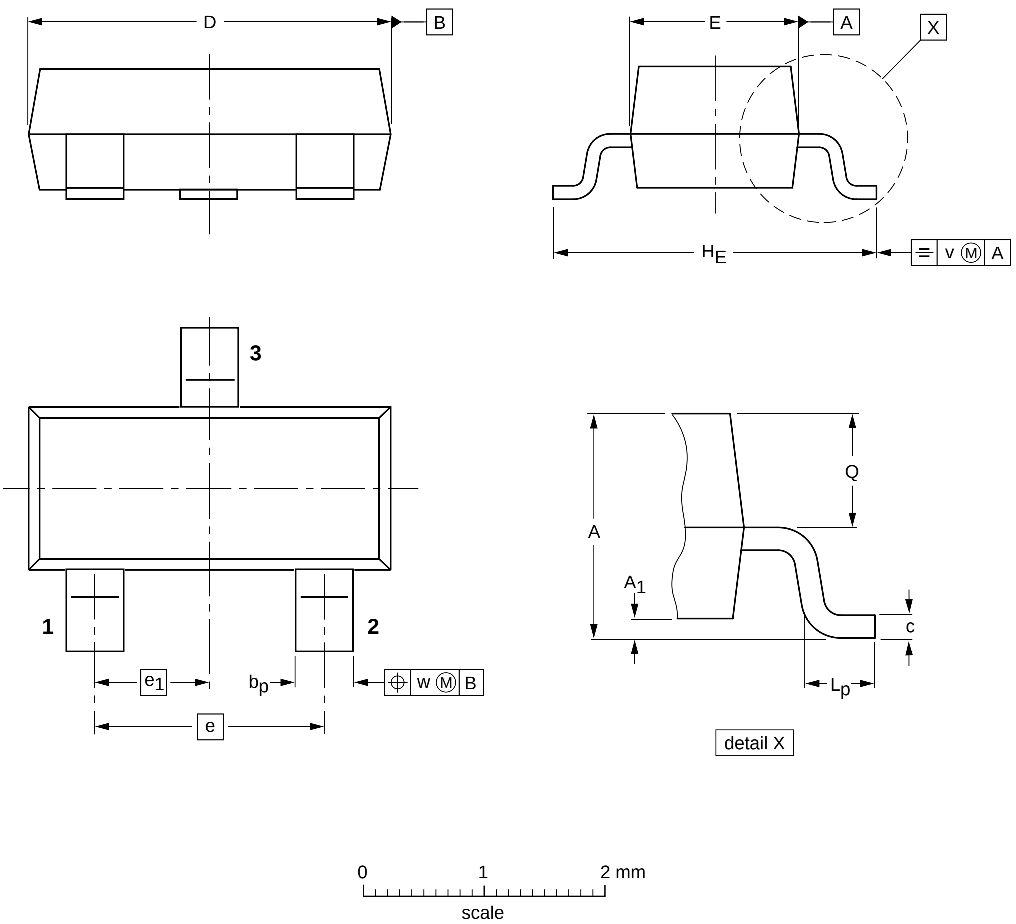


$$V_{GS} = 0V; f = 1MHz$$

Fig 12. Input, output and reverse transfer capacitances as a function of drain-source 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 13. Package outline SOT23 (TO-236AB)

9. Soldering

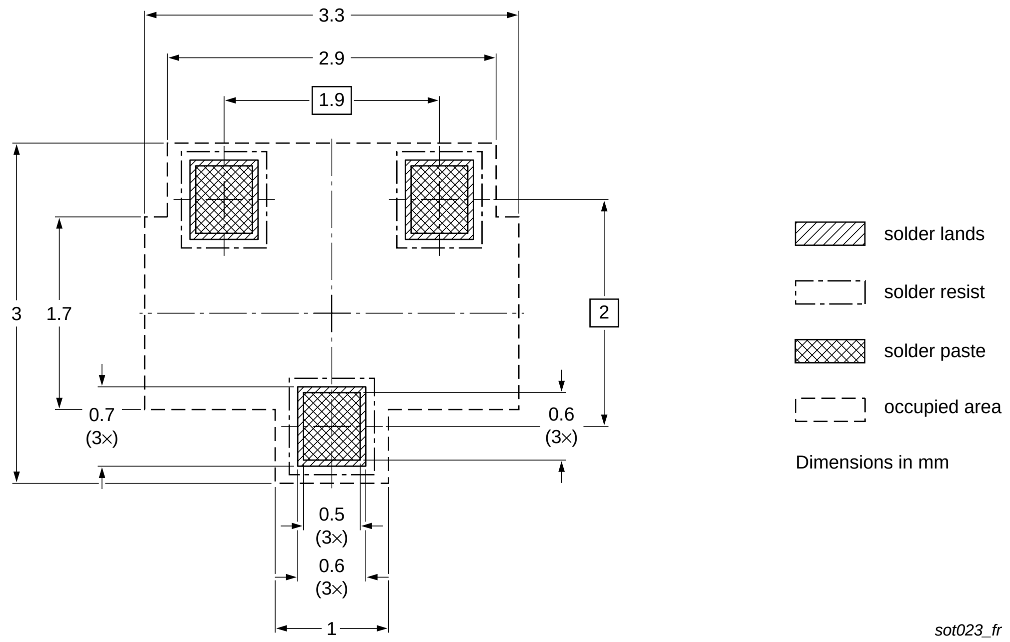


Fig 14. Reflow soldering footprint for SOT23 (TO-236AB)

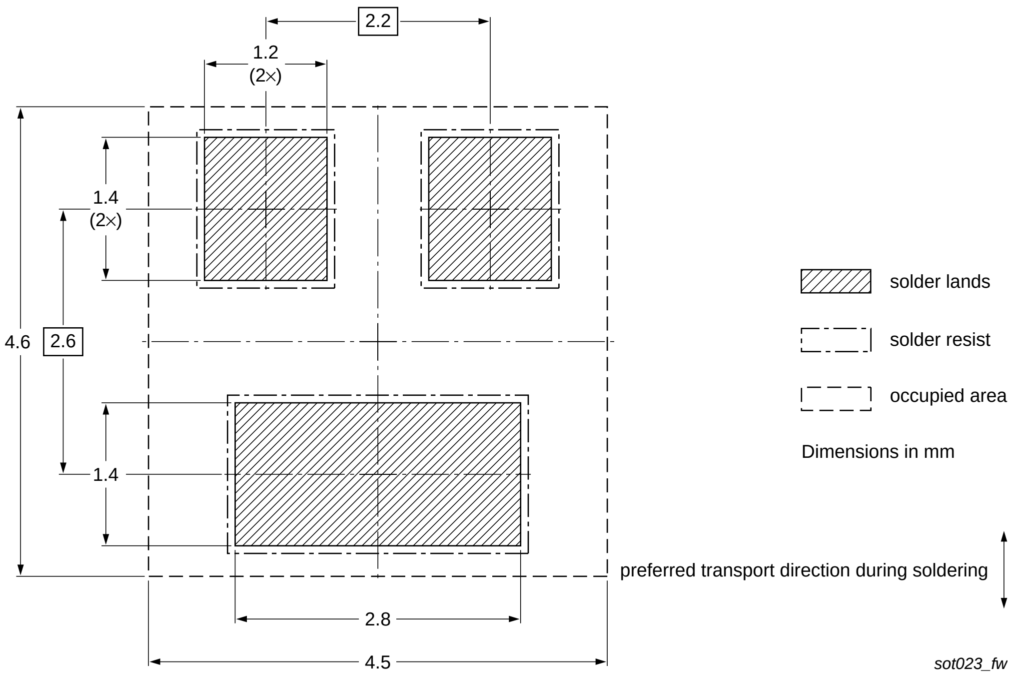


Fig 15. Wave soldering footprint for SOT23 (TO-236AB)

10. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
2N7002 v.7	20110908	Product data sheet	-	2N7002 v.6
Modifications:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate.			
2N7002 v.6	20060428	Product data sheet		2N7002 v.5
2N7002 v.5	20051115	Product data sheet		2N7002 v.4
2N7002 v.4	20050426	Product data sheet		2N7002 v.3
2N7002 v.3	20000727	Product specification	HZG336	2N7002 v.2
2N7002 v.2	19970617	Product specification		2N7002 v.1
2N7002 v.1	19901031	Product specification	-	-

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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