

2N7002

60 V, 300 mA N-channel Trench MOSFET Rev. 7 — 8 September 2011

Product data sheet

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	Тур	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 <u>Figure 1</u> ; see <u>Figure 3</u>	-	-	300	mA
P _{tot}	total power dissipation	T _{sp} = 25 °C; see <u>Figure 2</u>	-	-	0.83	W
Static charac	Static characteristics					
R _{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA; T_j = 25 °C; see <u>Figure 6</u> ; see <u>Figure 8</u>	-	2.8	5	Ω

Pinning information 2.

Table 2. **Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		_
2	S	source		D
3	D	drain	1 2	G (EA)
			SOT23 (TO-236AB)	mbb076 S



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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 $k\Omega$	-	60	V
V_{GS}	gate-source voltage		-30	30	V
V_{GSM}	peak gate-source voltage	pulsed; $t_p \le 50 \ \mu s$; $\delta = 0.25$	-40	40	V
I _D	drain current	$V_{GS} = 10 \text{ V}$; $T_{sp} = 25 \text{ °C}$; see <u>Figure 1</u> ; see <u>Figure 3</u>	-	300	mA
		$V_{GS} = 10 \text{ V}; T_{sp} = 100 \text{ °C}; \text{ see } \frac{\text{Figure 1}}{\text{Model}}$	-	190	mA
I _{DM}	peak drain current	pulsed; $t_p \le 10 \mu s$; $T_{sp} = 25 \text{ °C}$; see Figure 3	-	1.2	Α
P _{tot}	total power dissipation	T _{sp} = 25 °C; see <u>Figure 2</u>	-	0.83	W
Tj	junction temperature		-65	150	°C
T _{stg}	storage temperature		-65	150	°C
Source-drain	diode				
Is	source current	$T_{sp} = 25 ^{\circ}C$	-	300	mA
I _{SM}	peak source current	pulsed; $t_p \le 10 \ \mu s$; $T_{sp} = 25 \ ^{\circ}C$	-	1.2	Α

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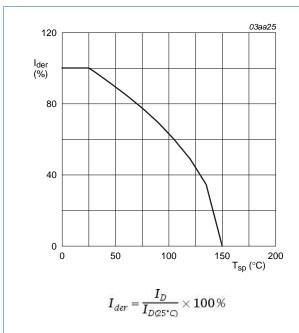


Fig 1. Normalized continuous drain current as a function of solder point temperature

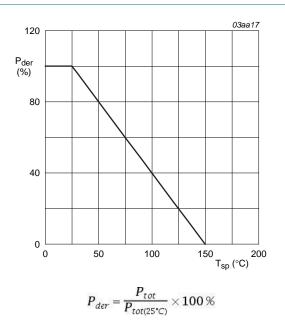
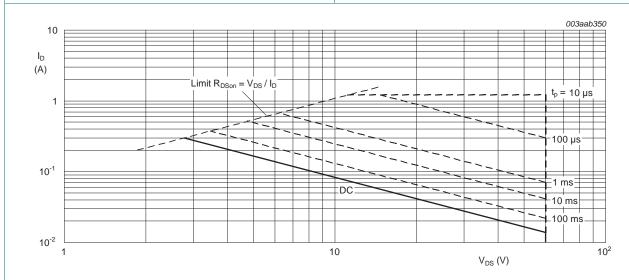


Fig 2. Normalized total power dissipation as a function of solder point temperature



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

Fig 3. Safe operating area; continous and peak drain currents as a function of drain-source voltage

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6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Тур	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

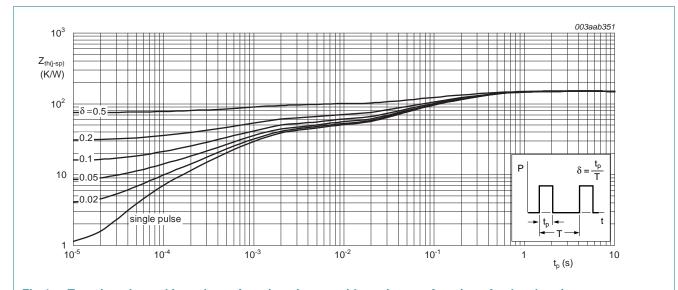


Fig 4. Transient thermal impedance from junction to solder point as a function of pulse duration

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7. Characteristics

Table 7. Characteristics

Table 7.	Characteristics					
Symbol	Parameter	Conditions	Min	Тур	Max	Unit
Static cha	aracteristics					
$V_{(BR)DSS}$	drain-source	$I_D = 10 \mu A; V_{GS} = 0 V; T_j = 25 °C$	60	-	-	V
	breakdown voltage	$I_D = 10 \mu A; V_{GS} = 0 V; T_j = -55 °C$	55	-	-	V
V_{GSth}	gate-source threshold voltage	$I_D = 0.25 \text{ mA}$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ °C}$; see <u>Figure 9</u> ; see <u>Figure 10</u>	1	2	2.5	V
		$I_D = 0.25 \text{ mA}$; $V_{DS} = V_{GS}$; $T_j = 150 ^{\circ}\text{C}$; see <u>Figure 9</u> ; see <u>Figure 10</u>	0.6	-	-	V
		$I_D = 0.25 \text{ mA}$; $V_{DS} = V_{GS}$; $T_j = -55 ^{\circ}\text{C}$; see <u>Figure 9</u> ; see <u>Figure 10</u>	-	-	2.75	V
I _{DSS}	drain leakage current	$V_{DS} = 48 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ °C}$	-	0.01	1	μΑ
		$V_{DS} = 48 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 150 ^{\circ}\text{C}$	-	-	10	μΑ
I _{GSS}	gate leakage current	$V_{GS} = 15 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ °C}$	-	10 1	100	nA
		$V_{GS} = -15 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ °C}$	-	10	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA; T_j = 25 °C; see <u>Figure 6</u> ; see <u>Figure 8</u>	-	2.8	5	Ω
		V_{GS} = 10 V; I_D = 500 mA; T_j = 150 °C; see <u>Figure 6</u> ; see <u>Figure 8</u>	-	-	9.25	Ω
		$V_{GS} = 4.5 \text{ V}; I_D = 75 \text{ mA}; T_j = 25 \text{ °C}; \text{see}$ Figure 6; see Figure 8	-	3.8	5.3	Ω
Dynamic	characteristics					
C _{iss}	input capacitance	$V_{DS} = 10 \text{ V; } f = 1 \text{ MHz; } V_{GS} = 0 \text{ V;}$	-	31	50	pF
C _{oss}	output capacitance	$T_j = 25 ^{\circ}\text{C}$	-	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 ;	-	2.5	10	ns
t _{off}	turn-off time	$R_{G(ext)} = 50 \Omega$; $R_{GS} = 50 \Omega$	-	11	15	ns
Source-d	rain diode					
V_{SD}	source-drain voltage	$I_S = 300 \text{ mA}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ °C}$; see Figure 11	-	0.85	1.5	V
Q _r	recovered charge	$V_{GS} = 0 \text{ V; } I_S = 300 \text{ mA;}$	-	30	-	nC
t _{rr}	reverse recovery time	$dI_S/dt = -100 A/\mu s$	-	30	-	ns

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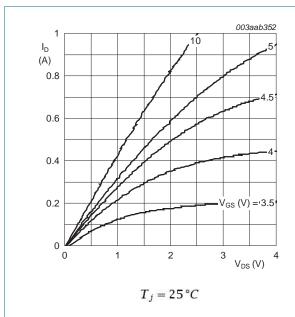


Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values

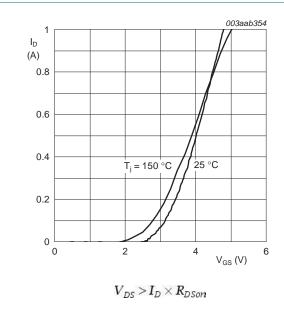


Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values

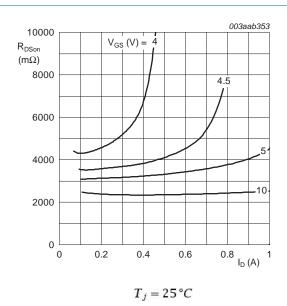


Fig 6. Drain-source on-state resistance as a function of drain current; typical values

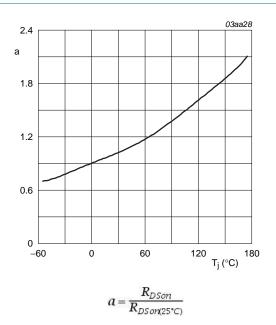


Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature

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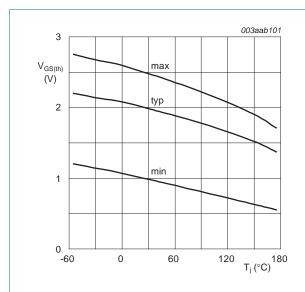


Fig 9. Gate-source threshold voltage as a function of junction temperature

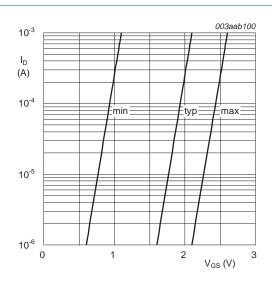


Fig 10. Sub-threshold drain current as a function of gate-source voltage

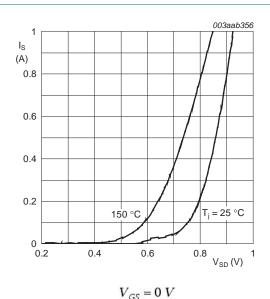


Fig 11. Source current as a function of source-drain voltage; typical values

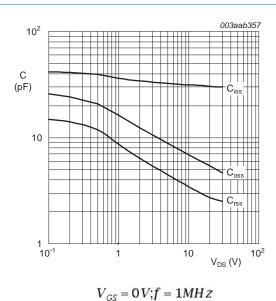


Fig 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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8. Package outline

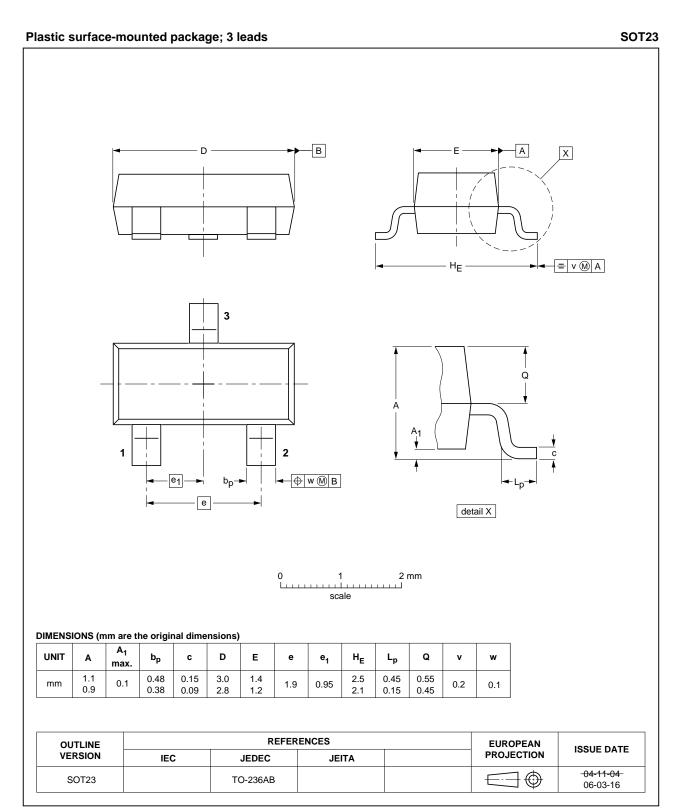


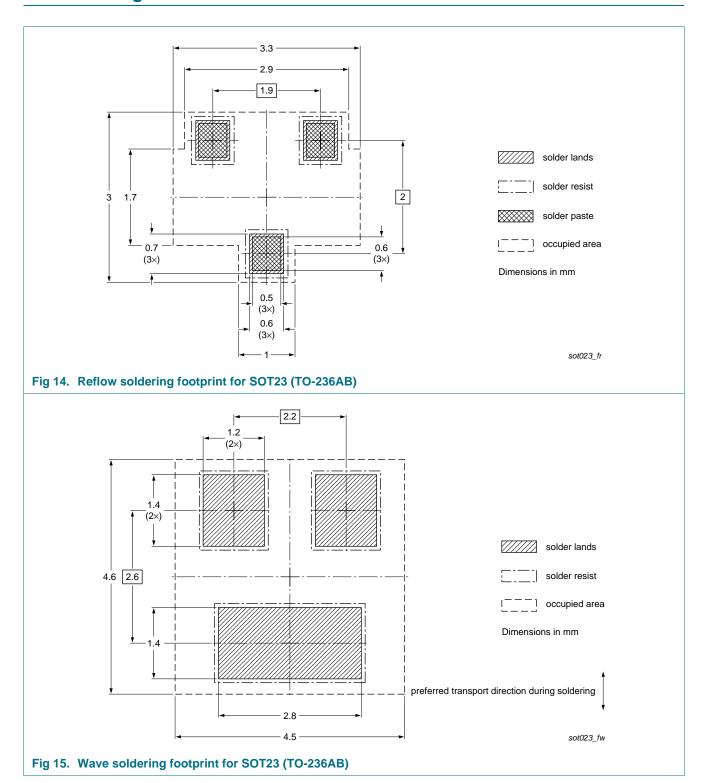
Fig 13. Package outline SOT23 (TO-236AB)

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9. Soldering



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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 to of NXP Semicon 		lesigned to comply with	the new identity guidelines
	 Legal texts have 	ve 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	-	-

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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.

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