

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	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 chara	acteristics					
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		
2	S	source		D
3	D	drain	1 2	G_(E)
			SOT23 (TO-236AB)	mbb076 S



60 V, 300 mA N-channel Trench MOSFET

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; $t_p \le 50 \ \mu s$; $\delta = 0.25$	-40	40	V
I _D	drain current	$V_{GS} = 10 \text{ V}$; $T_{sp} = 25 \text{ °C}$; see Figure 1; see Figure 3	-	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 °C	-	300	mA
I _{SM}	peak source current	pulsed; $t_p \le 10 \ \mu s$; $T_{sp} = 25 \ ^{\circ}C$	-	1.2	Α

60 V, 300 mA N-channel Trench MOSFET

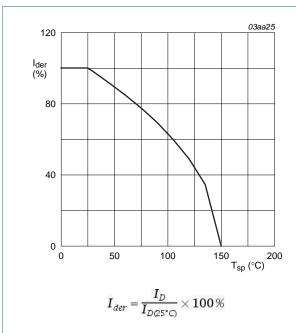


Fig 1. Normalized continuous drain current as a function of solder point temperature

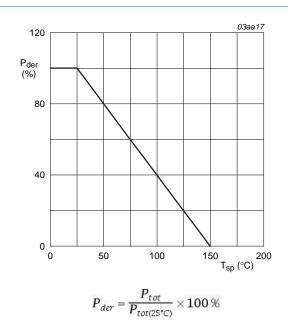
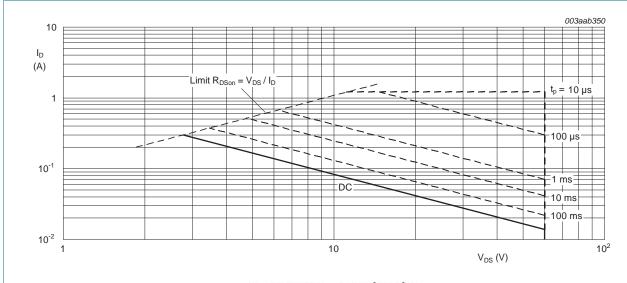


Fig 2. Normalized total power dissipation as a function of solder point temperature



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

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

60 V, 300 mA N-channel Trench MOSFET

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

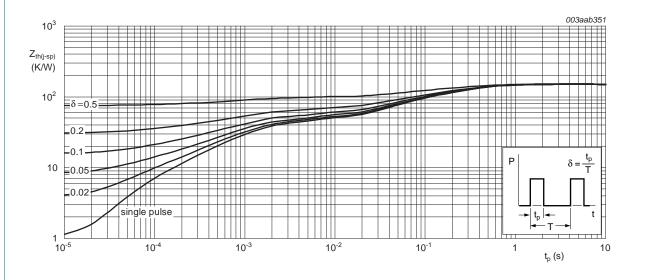


Fig 4. Transient thermal impedance from junction to solder point as a function of pulse duration

60 V, 300 mA N-channel Trench MOSFET

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	-	-	٧
	breakdown voltage	$I_D = 10 \mu A; V_{GS} = 0 V; T_j = -55 °C$	55	-	-	٧
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
		$I_D = 0.25$ mA; $V_{DS} = V_{GS}$; $T_j = -55$ °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	100	nΑ
		$V_{GS} = -15 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ °C}$	-	10	100	nΑ
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
Coss	output capacitance	T _j = 25 °C	-	6.8	30	pF
C _{rss}	reverse transfer capacitance		-	3.5	10	pF
t _{on}	turn-on time	$V_{GS} = 10 \text{ V}; V_{DS} = 50 \text{ V}; R_L = 250 \Omega;$	-	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 mA; V_{GS} = 0 V; T_j = 25 °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

60 V, 300 mA N-channel Trench MOSFET

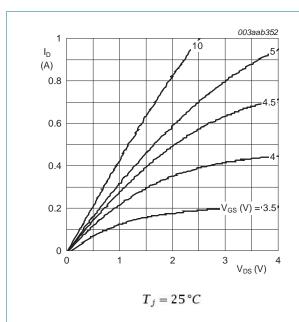


Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values

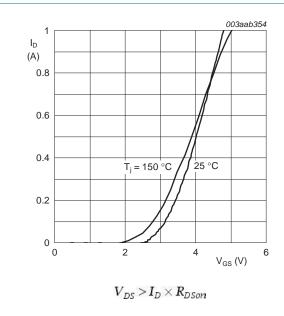


Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values

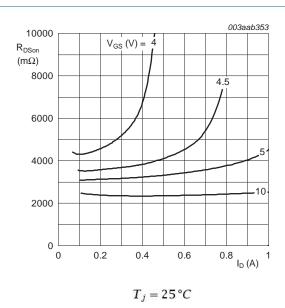


Fig 6. Drain-source on-state resistance as a function of drain current; typical values

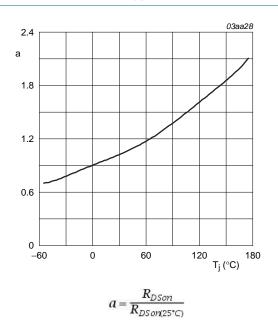


Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature

60 V, 300 mA N-channel Trench MOSFET

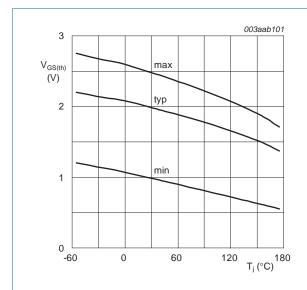


Fig 9. Gate-source threshold voltage as a function of junction temperature

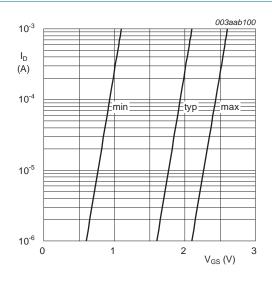


Fig 10. Sub-threshold drain current as a function of gate-source voltage

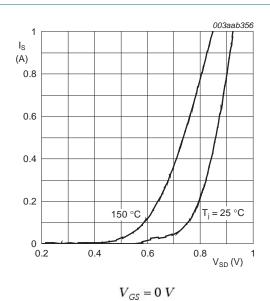
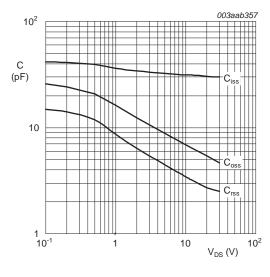


Fig 11. Source current as a function of source-drain voltage; typical values



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

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

60 V, 300 mA N-channel Trench MOSFET

8. Package outline

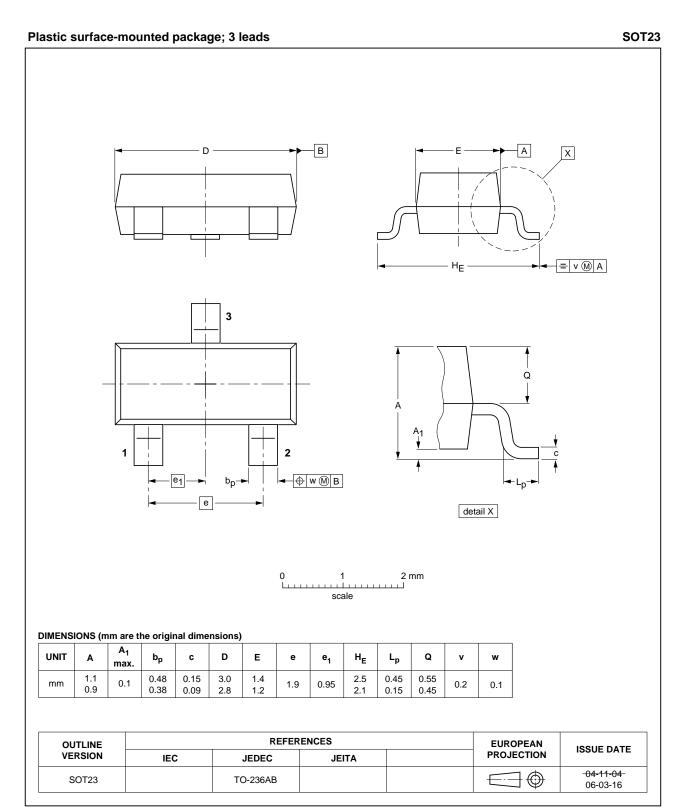
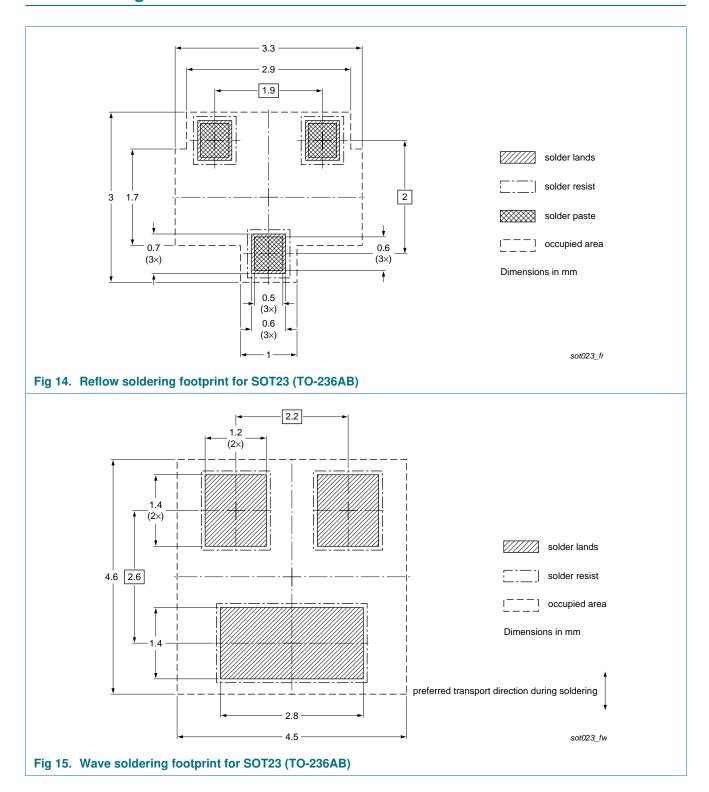


Fig 13. Package outline SOT23 (TO-236AB)

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60 V, 300 mA N-channel Trench MOSFET

9. Soldering



60 V, 300 mA N-channel Trench MOSFET

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 redesi of NXP Semiconductors.		lesigned to comply with	n the new identity guidelines	
	 Legal texts have 	ve been adapted to the new	company name where	appropriate.
2N7002 v.6	20060428	Product data sheet	et 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	-	-

60 V, 300 mA N-channel Trench MOSFET

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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.

- [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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2N7002

60 V, 300 mA N-channel Trench MOSFET

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60 V, 300 mA N-channel Trench MOSFET

13. Contents

1	Product profile
1.1	General description
1.2	Features and benefits1
1.3	Applications1
1.4	Quick reference data1
2	Pinning information1
3	Ordering information
4	Marking
5	Limiting values
6	Thermal characteristics4
7	Characteristics
8	Package outline
9	Soldering
10	Revision history10
11	Legal information11
11.1	Data sheet status
11.2	Definitions11
11.3	Disclaimers
11.4	Trademarks12
12	Contact information 13