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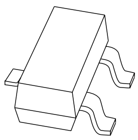


2N7002T

N-channel TrenchMOS FET

Rev. 01 — 17 November 2005 **Product data sheet**

1. Product profile

1.1 General description

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

1.2 Features

- Logic level threshold compatible
- Surface-mounted package
- Very fast switching
- TrenchMOS technology

1.3 Applications

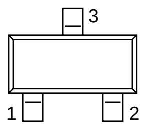
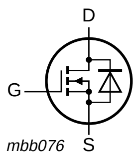
- Logic level translator
- High-speed line driver

1.4 Quick reference data

- $V_{DS} \leq 60$ V
- $R_{DSon} \leq 5\ \Omega$
- $I_D \leq 300$ mA
- $P_{tot} \leq 0.83$ W

2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	gate (G)	 SOT23	
2	source (S)		
3	drain (D)		

3. Ordering information

Table 2: Ordering information

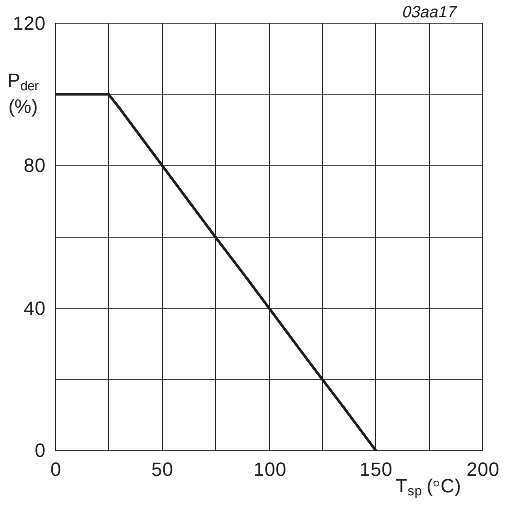
Type number	Package		
	Name	Description	Version
2N7002T	TO-236AB	plastic surface mounted package; 3 leads	SOT23

4. Limiting values

Table 3: Limiting values

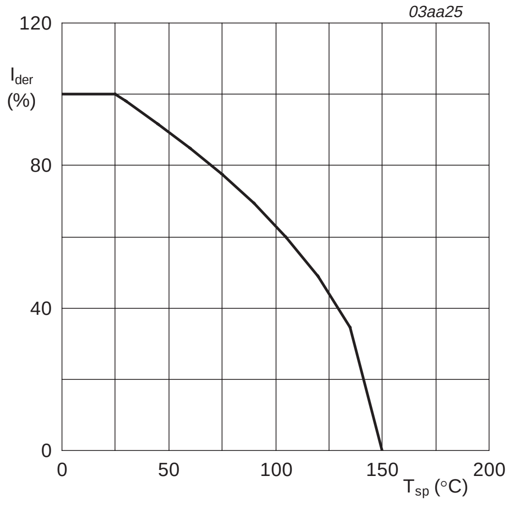
In accordance with the Absolute Maximum Rating System (IEC 60134).

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



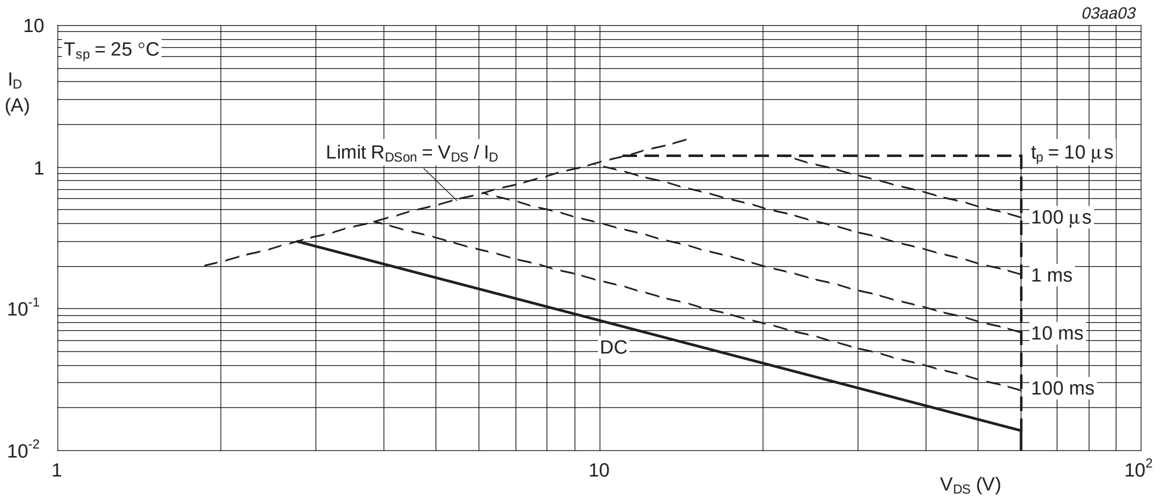
$$P_{der} = \frac{P_{tot}}{P_{tot(25\,^{\circ}C)}} \times 100\,\%$$

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



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

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



T_{sp} = 25 °C; I_{DM} is single pulse

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

5. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	see Figure 4	-	-	150	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	[1]	-	-	350	K/W

[1] Mounted on a printed-circuit board; minimum footprint; vertical in still air

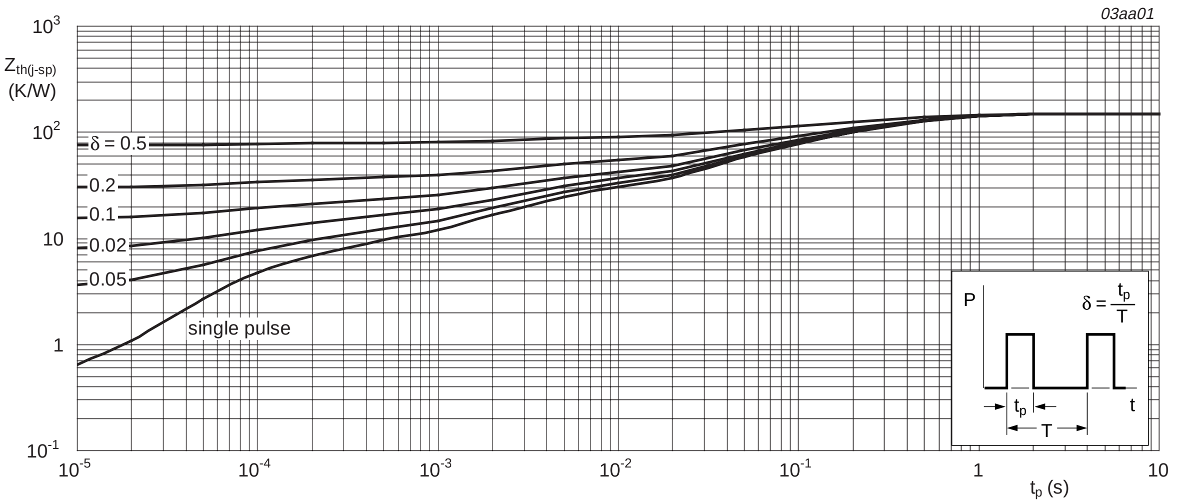


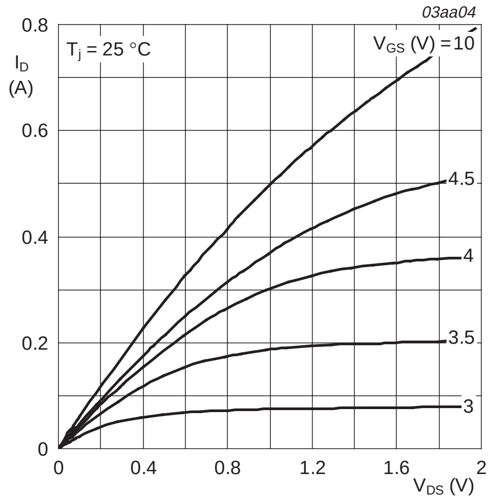
Fig 4. Transient thermal impedance from junction to solder point as a function of pulse duration

6. Characteristics

Table 5: Characteristics

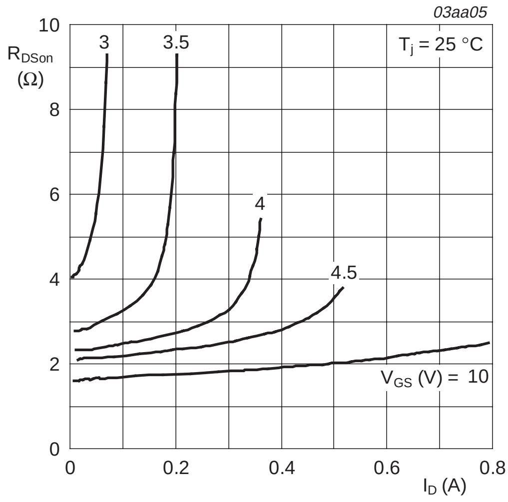
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 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 = 1 mA; V_{DS} = V_{GS}; see Figure 9 and 10				
		T_j = 25 °C	1	2	2.5	V
		T_j = 150 °C	0.6	-	-	V
		T_j = –55 °C	-	-	2.75	V
I_{DSS}	drain leakage current	V_{DS} = 48 V; V_{GS} = 0 V				
		T_j = 25 °C	-	0.01	1	μA
		T_j = 150 °C	-	-	10	μA
I_{GSS}	gate leakage current	V_{GS} = ±15 V; V_{DS} = 0 V	-	10	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA; see Figure 6 and 8				
		T_j = 25 °C	-	2.8	5	Ω
		T_j = 150 °C	-	-	9.25	Ω
		V_{GS} = 4.5 V; I_D = 75 mA; see Figure 6 and 8	-	3.8	5.3	Ω
Dynamic characteristics						
g_{fs}	transfer conductance	V_{GS} = 10 V; I_D = 200 mA; see Figure 11	100	300	-	mS
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 10 V; f = 1 MHz; see Figure 12	-	25	40	pF
C_{oss}	output capacitance		-	18	30	pF
C_{rss}	reverse transfer capacitance		-	7.5	10	pF
t_{on}	turn-on time	V_{DS} = 50 V; R_L = 250 Ω; V_{GS} = 10 V; R_G = 50 Ω; R_{GS} = 50 Ω	-	3	10	ns
t_{off}	turn-off time		-	12	12	ns
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 300 mA; V_{GS} = 0 V; see Figure 13	-	0.85	1.5	V
t_{rr}	reverse recovery time	I_S = 300 mA; dI_S/dt = –100 A/μs; V_{GS} = 0 V	-	30	-	ns
Q_r	recovered charge		-	30	-	nC



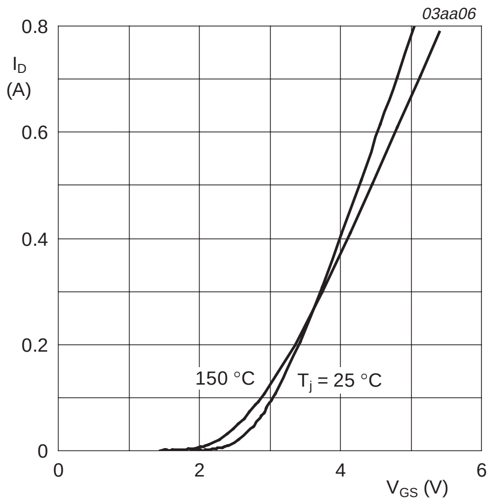
T_j = 25 °C

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



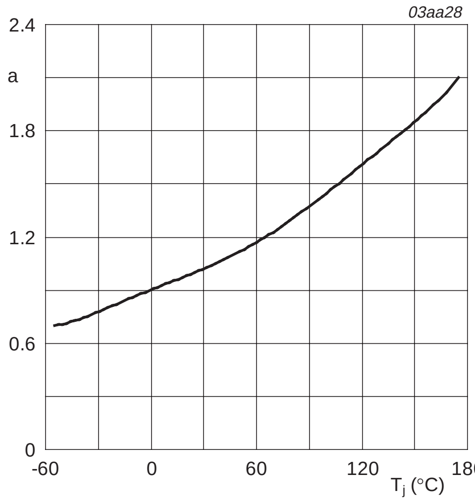
T_j = 25 °C

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



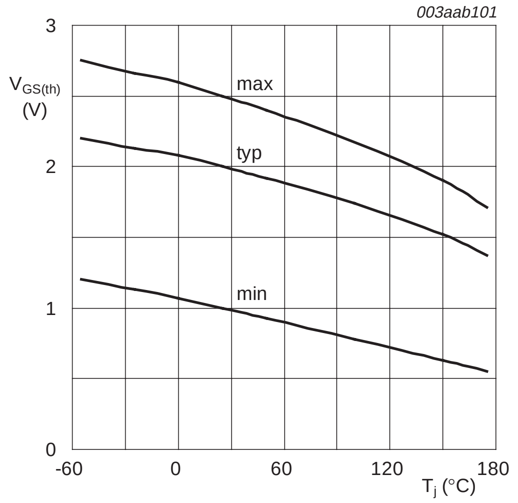
T_j = 25 °C and 150 °C; $V_{DS} > I_D \times R_{DSon}$

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



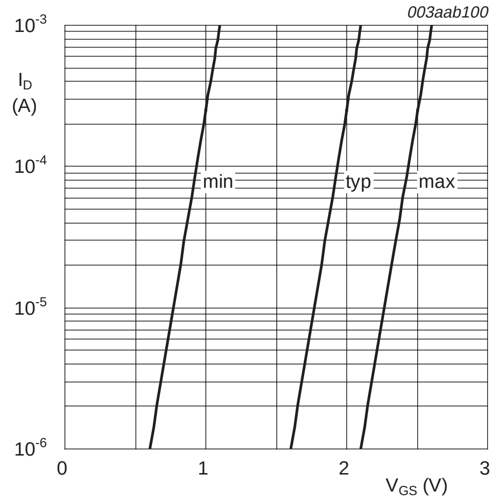
$$a = \frac{R_{DSon}}{R_{DSon(25\,^{\circ}C)}}$$

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



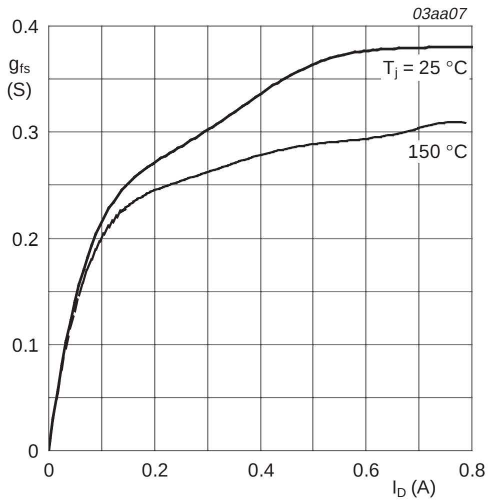
I_D = 1 mA; $V_{DS} = V_{GS}$

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



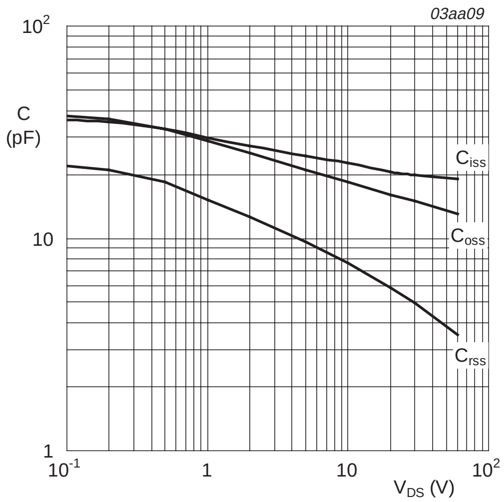
T_j = 25 °C; V_{DS} = 5 V

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



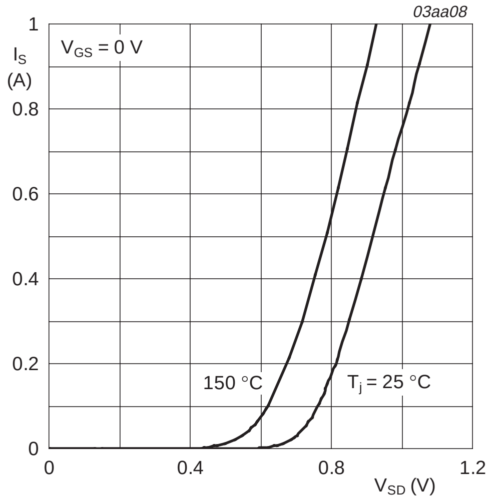
T_j = 25 °C and 150 °C; $V_{DS} > I_D \times R_{DSon}$

Fig 11. Transfer conductance as a function of drain current; typical values



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

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

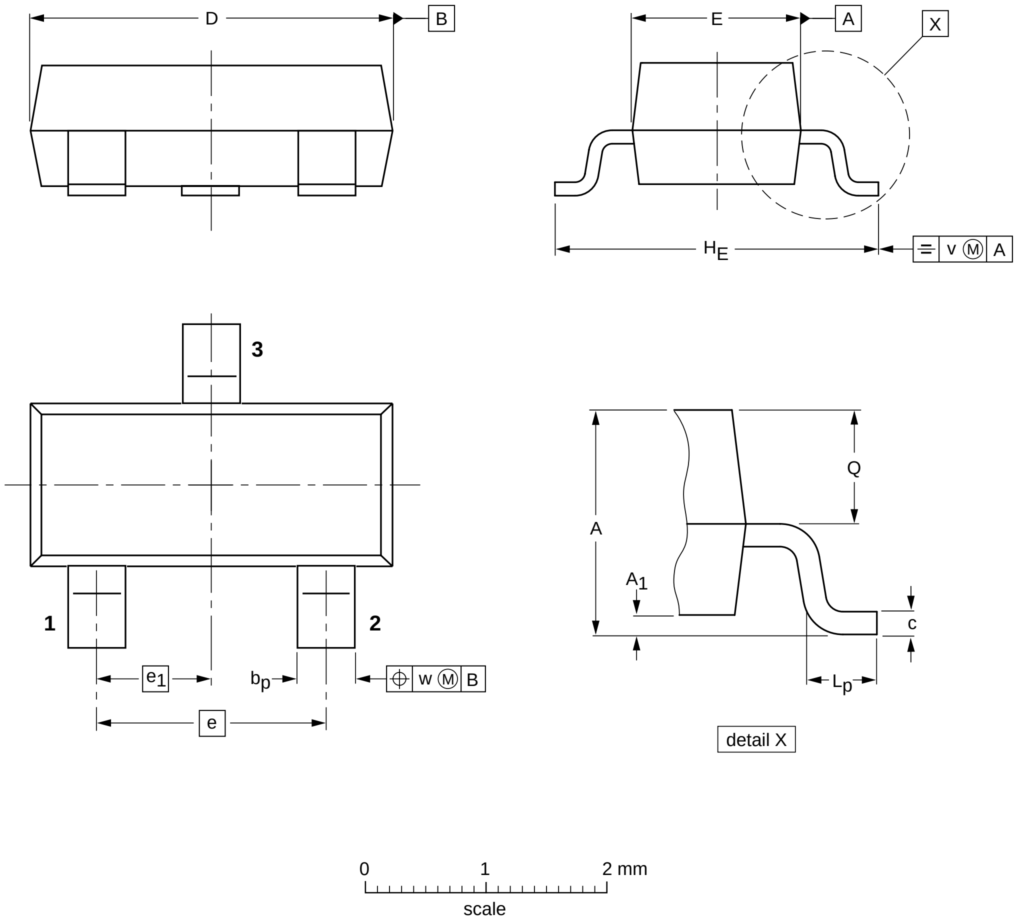


T_j = 25 °C and 150 °C; V_{GS} = 0 V

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

7. 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

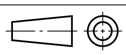
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT23		TO-236AB				~~99-09-13~~ 04-11-04

Fig 14. Package outline SOT23

8. Revision history

Table 6: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
2N7002T_1	20051117	Product data sheet	-	-	-

9. Data sheet status

Level	Data sheet status [1]	Product status [2] [3]	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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14. Contents

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