DATA SHEET

2N7002
N-channel vertical D-MOS transistor

Product specification
File under Discrete Semiconductors, SC13b

April 1995

Philips Semiconductors

PHILIPS

N-channel vertical D-MOS transistor 2N7002

FEATURES

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No secondary breakdown.

DESCRIPTION

N-channel enhancement mode vertical D-MOS transistor in a SOT23 envelope. It is designed for use as a Surface Mounted Device (SMD) in thin and thick-film circuits, with applications in relay, high-speed and line transformer drivers.

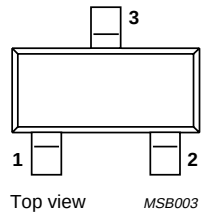
PINNING - SOT23

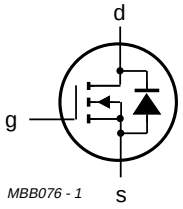
PIN	DESCRIPTION
1	gate
2	source
3	drain

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{DS}	drain-source voltage		60	V
I_D	drain current	DC value	180	mA
$R_{DS(on)}$	drain-source on-resistance	I_D = 500 mA V_{GS} = 10 V	5	Ω
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA V_{GS} = V_{DS}	3	V

PIN CONFIGURATION





Marking code: 702

Fig.1 Simplified outline and symbol.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	60	V
$\pm V_{GSO}$	gate-source voltage	open drain	–	40	V
I_D	drain current	DC value	–	180	mA
I_{DM}	drain current	peak value	–	800	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C (note 1) (note 2)	 – –	 300 250	 mW mW
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

Notes

1. Mounted on a ceramic substrate measuring $10 \times 8 \times 0.7$ mm.
2. Mounted on a printed circuit board.

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient	note 1 note 2	430 500	K/W K/W

Notes

1. Mounted on a ceramic substrate measuring $10 \times 8 \times 0.7$ mm.
2. Mounted on a printed circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 μA V_{GS} = 0	60	90	–	V
I_{DSS}	drain-source leakage current	V_{DS} = 48 V V_{GS} = 0	–	–	1	μA
$\pm I_{GSS}$	gate-source leakage current	V_{DS} = 0 $\pm V_{GS}$ = 15 V	–	–	10	nA
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA V_{GS} = V_{DS}	0.8	–	3	V
$R_{DS(on)}$	drain-source on-resistance	I_D = 500 mA V_{GS} = 10 V	–	3.5	5	Ω
		I_D = 75 mA V_{GS} = 4.5 V	–	–	5.3	Ω
$\lvert Y_{fs} \rvert$	transfer admittance	I_D = 200 mA V_{DS} = 10 V	100	200	–	mS
C_{iss}	input capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	25	40	pF
C_{oss}	output capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	22	30	pF
C_{rss}	feedback capacitance	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz	–	6	10	pF
Switching times (see Figs 2 **and** 3**)**						
t_{on}	turn-on time	I_D = 200 mA V_{DD} = 50 V V_{GS} = 0 to 10 V	–	–	10	ns
t_{off}	turn-off time	I_D = 200 mA V_{DD} = 50 V V_{GS} = 0 to 10 V	–	–	15	ns

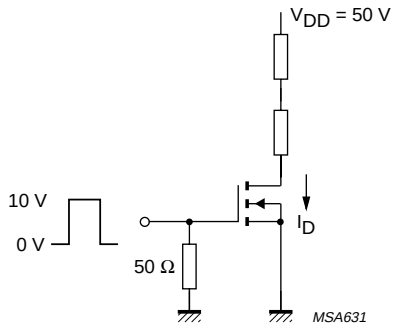


Fig.2 Switching time test circuit.

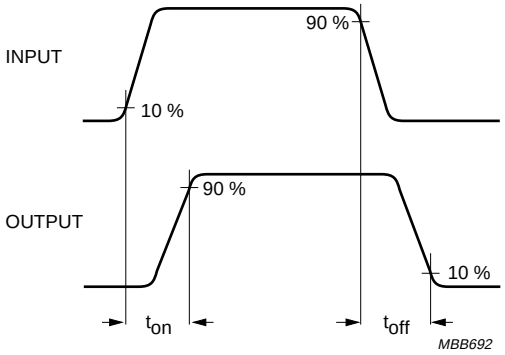
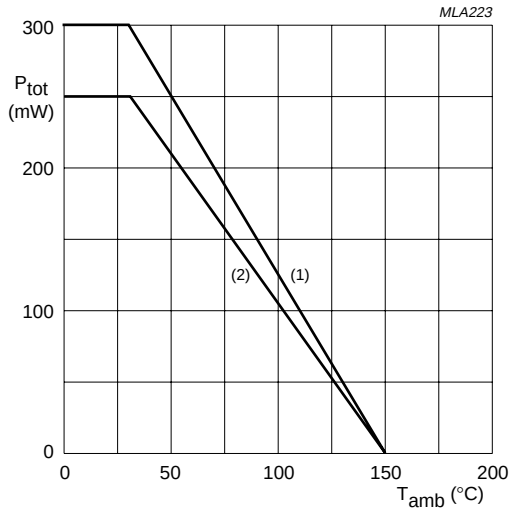


Fig.3 Input and output waveforms.



(1) On ceramic substrate.
(2) On printed circuit board.

Fig.4 Power derating curve.

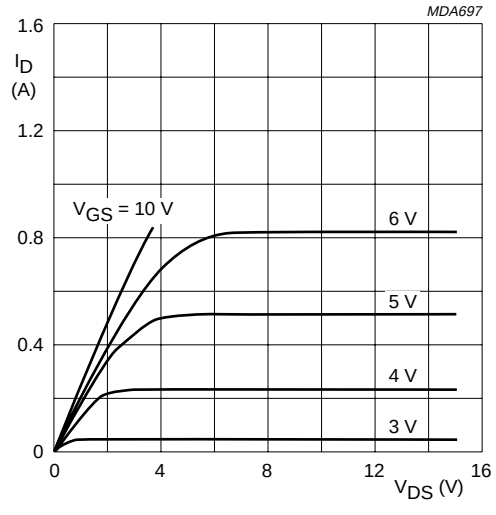


Fig.5 Typical output characteristics; T_j = 25 °C.

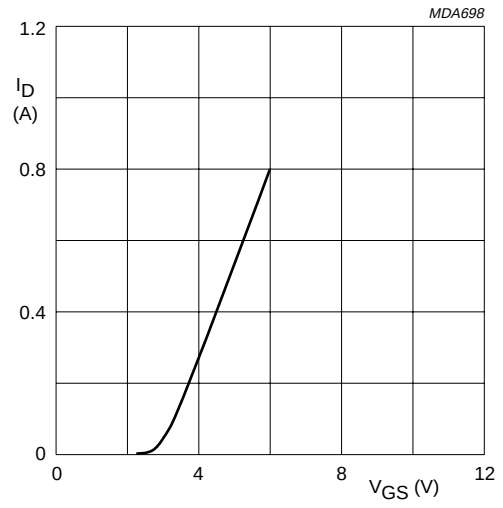


Fig.6 Typical transfer characteristic; V_{DS} = 10 V; T_j = 25 °C.

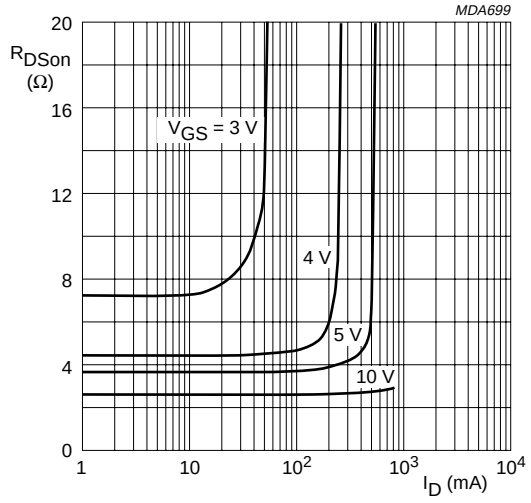


Fig.7 Typical on-resistance as a function of drain current; T_j = 25 °C.

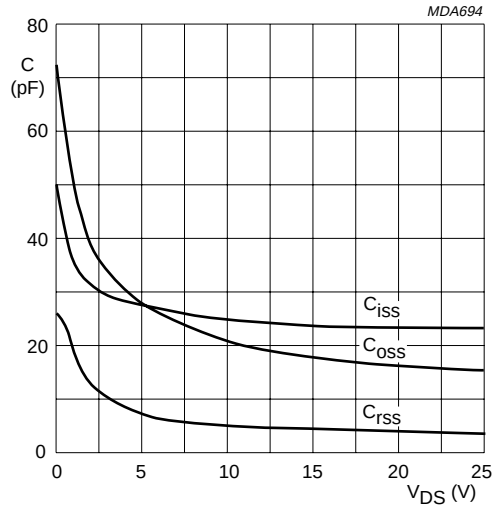
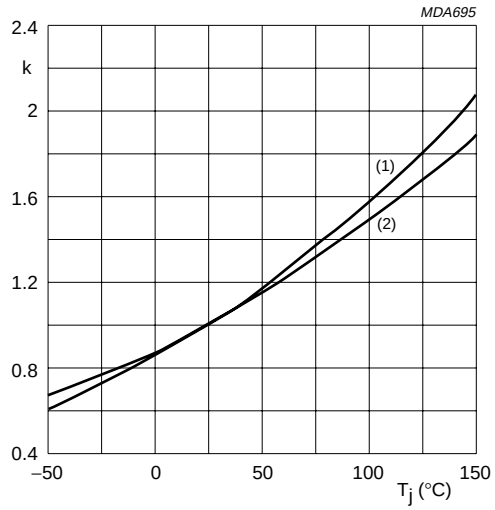


Fig.8 Typical capacitances as a function of drain-source voltage; V_{GS} = 0; f = 1 MHz; T_j = 25 °C.



(1) I_D = 500 mA; V_{GS} = 10 V.
(2) I_D = 75 mA; V_{GS} = 4.5 V.

Fig.9 Temperature coefficient of drain-source on-resistance;

$$k = \frac{R_{DS(on)} \text{ at } T_j}{R_{DS(on)} \text{ at } 25\ °C}$$

typical $R_{DS(on)}$.

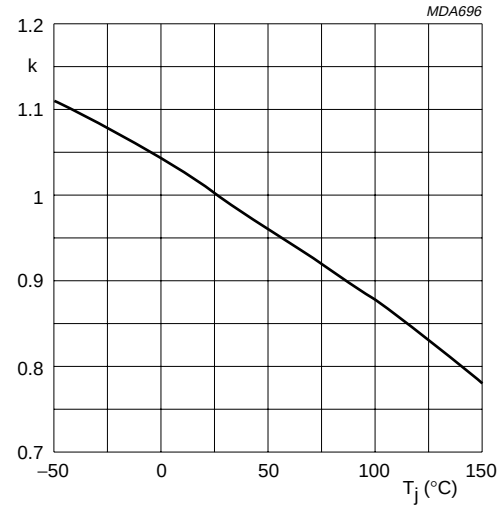


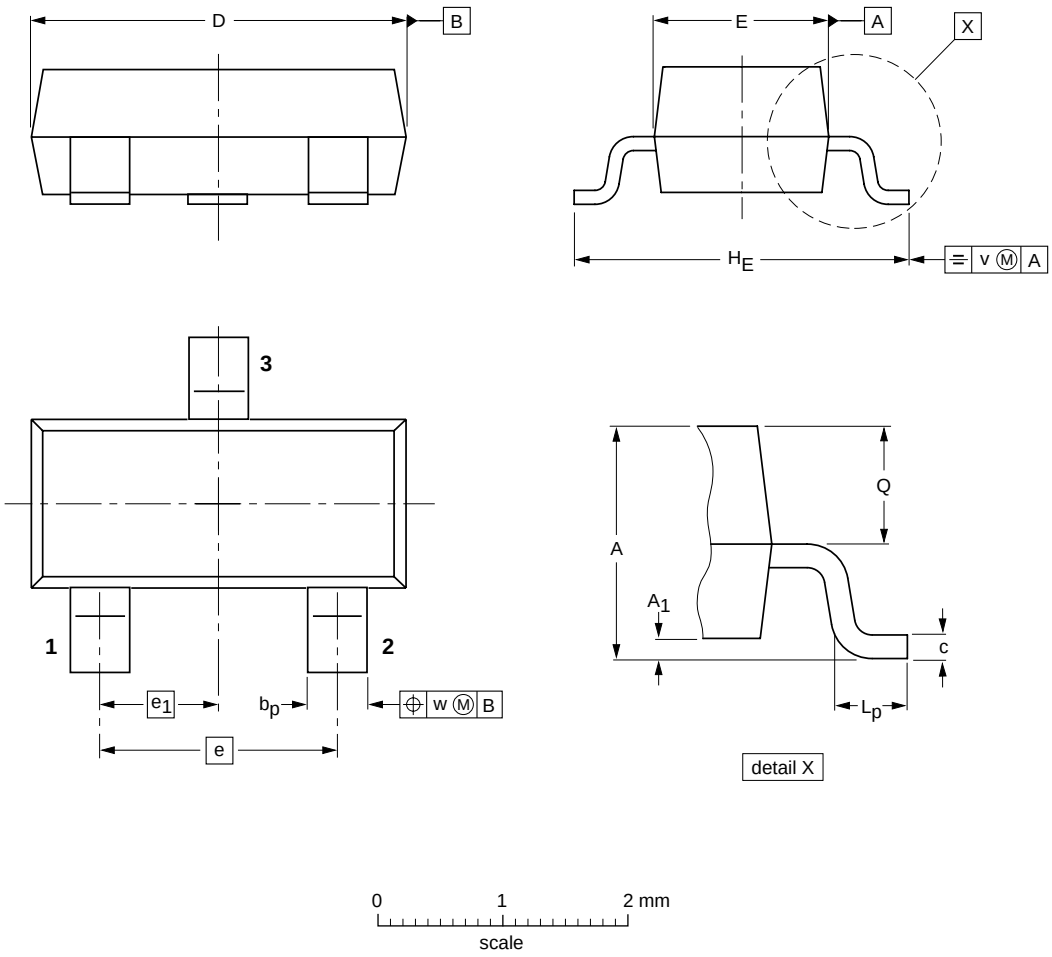
Fig.10 Temperature coefficient of gate-source threshold voltage;

$$k = \frac{V_{GS(th)} \text{ at } T_j}{V_{GS(th)} \text{ at } 25\ °C}$$

typical $V_{GS(th)}$ at 1 mA.

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	EIAJ			
SOT23						97-02-28

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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SCA54

Printed in The Netherlands 137107/00/01/pp12 Date of release: April 1995 Document order number: 9397 750 02442

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