

DATA SHEET

PHN103

N-channel enhancement mode
MOS transistor

Product specification
Supersedes data of 1996 Nov 12
File under Discrete Semiconductors, SC13b

1997 Jun 20

N-channel enhancement mode
MOS transistor

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FEATURES

- High-speed switching
- No secondary breakdown
- Very low on-state resistance.

APPLICATIONS

- Motor and actuator driver
- Power management
- Synchronized rectification.

DESCRIPTION

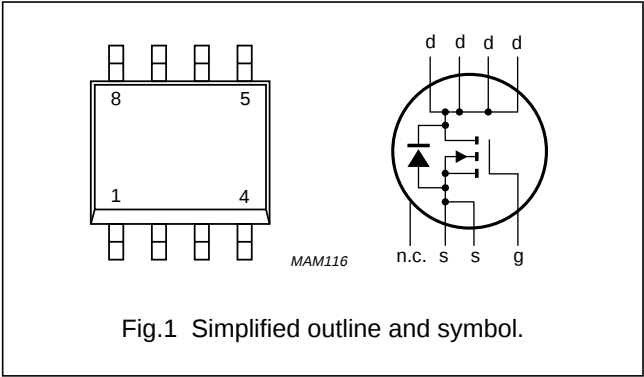
N-channel enhancement mode MOS transistor in an 8-pin plastic SOT96-1 (SO8) package.

CAUTION

The device is supplied in an antistatic package.
The gate-source input must be protected against static discharge during transport or handling.

PINNING - SOT96-1 (SO8)

PIN	SYMBOL	DESCRIPTION
1	n.c	not connected
2	s	source
3	s	source
4	g	gate
5	d	drain
6	d	drain
7	d	drain
8	d	drain



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage (DC)		–	30	V
V_{SD}	source-drain diode forward voltage	$I_S = 1.25\text{ A}$	–	1	V
V_{GS}	gate-source voltage (DC)		–	± 20	V
V_{GSth}	gate-source threshold voltage	$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$	1	2.8	V
I_D	drain current (DC)	$T_S = 80\text{ }^\circ\text{C}$	–	8.5	A
R_{DSon}	drain-source on-state resistance	$I_D = 5.5\text{ A}$; $V_{GS} = 10\text{ V}$	–	0.03	Ω
P_{tot}	total power dissipation	$T_S = 80\text{ }^\circ\text{C}$	–	4	W

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LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage (DC)		–	30	V
V_{GS}	gate-source voltage (DC)		–	± 20	V
I_D	drain current (DC)	$T_S = 80\text{ }^{\circ}\text{C}$; note 1	–	8.5	A
I_{DM}	peak drain current	note 2	–	35	A
P_{tot}	total power dissipation	$T_S = 80\text{ }^{\circ}\text{C}$	–	4	W
		$T_{amb} = 25\text{ }^{\circ}\text{C}$; note 3	–	2.7	W
		$T_{amb} = 25\text{ }^{\circ}\text{C}$; note 4	–	1.15	W
T_{stg}	storage temperature		–65	+150	$^{\circ}\text{C}$
T_j	operating junction temperature		–65	+150	$^{\circ}\text{C}$
Source-drain diode					
I_S	source current (DC)	$T_S = 80\text{ }^{\circ}\text{C}$	–	5	A
I_{SM}	peak pulsed source current	note 2	–	20	A

Notes

- T_S is the temperature at the soldering point of the drain lead.
- Pulse width and duty cycle limited by maximum junction temperature.
- Device mounted on printed-circuit board with an $R_{th\ a-tp}$ (ambient to tie-point) of 27.5 K/W.
- Device mounted on printed-circuit board with an $R_{th\ a-tp}$ (ambient to tie-point) of 90 K/W.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to soldering point	17.5	K/W

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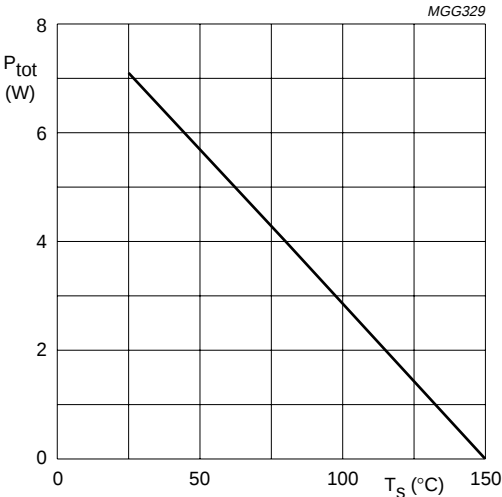
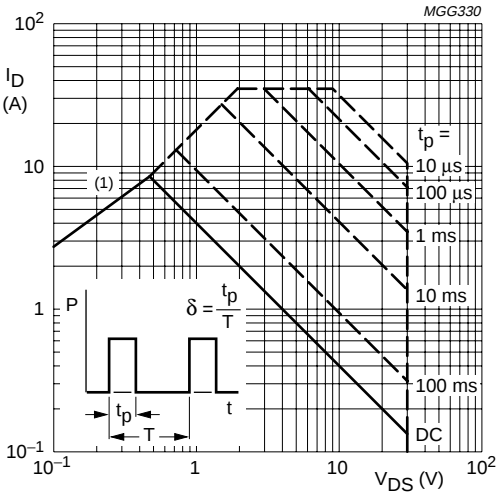


Fig.2 Power derating curve.



$\delta = 0.01$; $T_s = 80$ °C.
(1) $R_{DS(on)}$ limitation.

Fig.3 SOAR.

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CHARACTERISTICS $T_j = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0$; $I_D = 10\text{ }\mu\text{A}$	30	—	—	V
V_{GSth}	gate-source threshold voltage	$V_{GS} = V_{DS}$; $I_D = 1\text{ mA}$	1	—	2.8	V
I_{DSS}	drain-source leakage current	$V_{GS} = 0$; $V_{DS} = 24\text{ V}$	—	—	100	nA
I_{GSS}	gate leakage current	$V_{GS} = \pm 20\text{ V}$; $V_{DS} = 0$	—	—	± 100	nA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}$; $I_D = 2.75\text{ A}$	—	—	0.05	Ω
		$V_{GS} = 10\text{ V}$; $I_D = 5.5\text{ A}$	—	—	0.03	Ω
C_{iss}	input capacitance	$V_{GS} = 0$; $V_{DS} = 24\text{ V}$; $f = 1\text{ MHz}$	—	750	—	pF
C_{oss}	output capacitance	$V_{GS} = 0$; $V_{DS} = 24\text{ V}$; $f = 1\text{ MHz}$	—	520	—	pF
C_{rss}	reverse transfer capacitance	$V_{GS} = 0$; $V_{DS} = 24\text{ V}$; $f = 1\text{ MHz}$	—	200	—	pF
Q_G	total gate charge	$V_{GS} = 10\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 4\text{ A}$	—	25	40	nC
Q_{GS}	gate-source charge	$V_{GS} = 10\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 4\text{ A}$	—	3	—	nC
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 4\text{ A}$	—	7.5	—	nC
Switching times (see Fig.4)						
$t_{d(on)}$	turn-on delay time	$V_{GS} = 0\text{ to }10\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 1\text{ A}$; $R_L = 15\text{ }\Omega$; $R_{gen} = 6\text{ }\Omega$	—	7	—	ns
t_r	rise time	$V_{GS} = 0\text{ to }10\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 1\text{ A}$; $R_L = 15\text{ }\Omega$; $R_{gen} = 6\text{ }\Omega$	—	10	—	ns
t_{on}	turn-on switching time	$V_{GS} = 0\text{ to }10\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 1\text{ A}$; $R_L = 15\text{ }\Omega$; $R_{gen} = 6\text{ }\Omega$	—	17	35	ns
$t_{d(off)}$	turn-off delay time	$V_{GS} = 10\text{ to }0\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 1\text{ A}$; $R_L = 15\text{ }\Omega$; $R_{gen} = 6\text{ }\Omega$	—	35	—	ns
t_f	fall time	$V_{GS} = 10\text{ to }0\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 1\text{ A}$; $R_L = 15\text{ }\Omega$; $R_{gen} = 6\text{ }\Omega$	—	40	—	ns
t_{off}	turn-off switching time	$V_{GS} = 10\text{ to }0\text{ V}$; $V_{DD} = 15\text{ V}$; $I_D = 1\text{ A}$; $R_L = 15\text{ }\Omega$; $R_{gen} = 6\text{ }\Omega$	—	75	150	ns
Source-drain diode						
V_{SD}	source-drain diode forward voltage	$V_{GD} = 0$; $I_S = 1.25\text{ A}$	—	—	1	V
t_{rr}	reverse recovery time	$I_S = 1.25\text{ A}$; $di/dt = 100\text{ A}/\mu\text{s}$	—	70	—	ns

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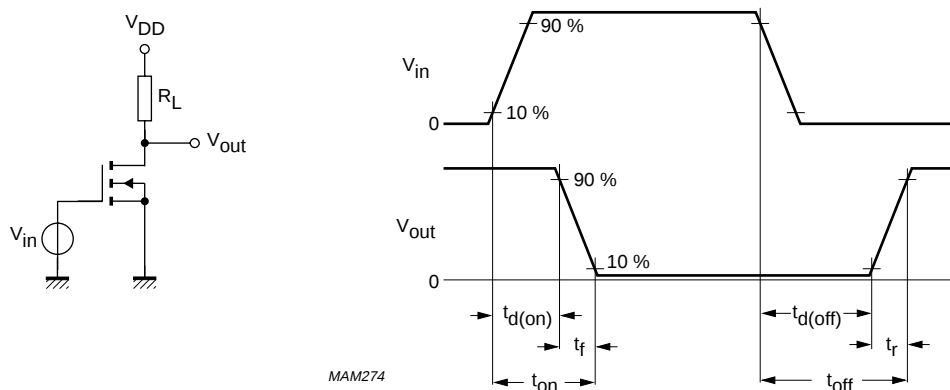
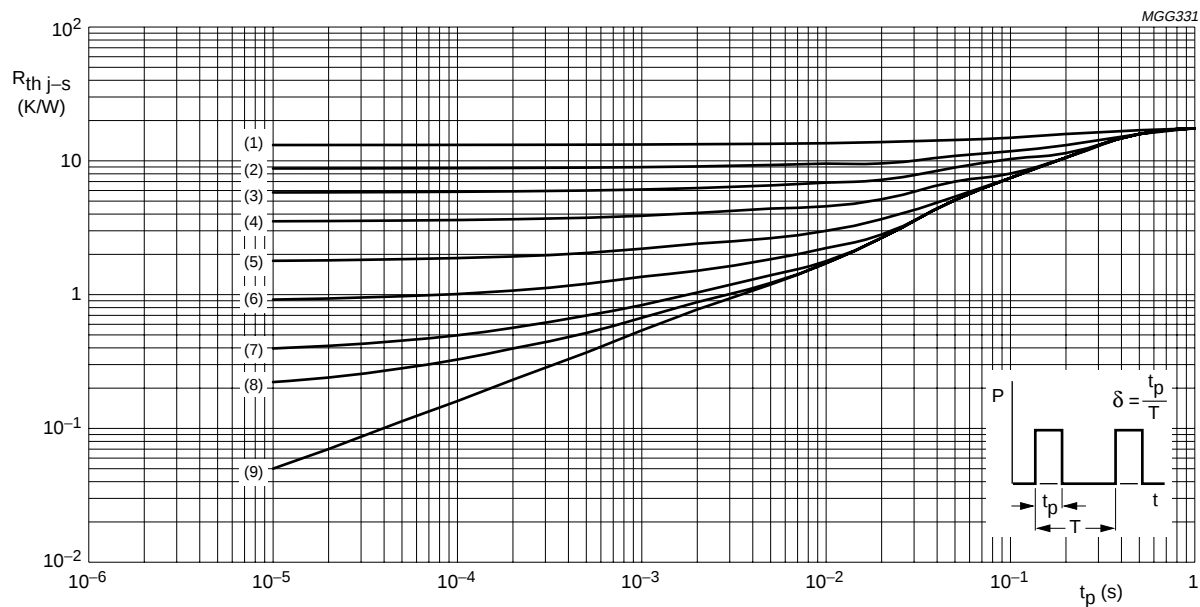


Fig.4 Switching times test circuit; input and output waveforms.

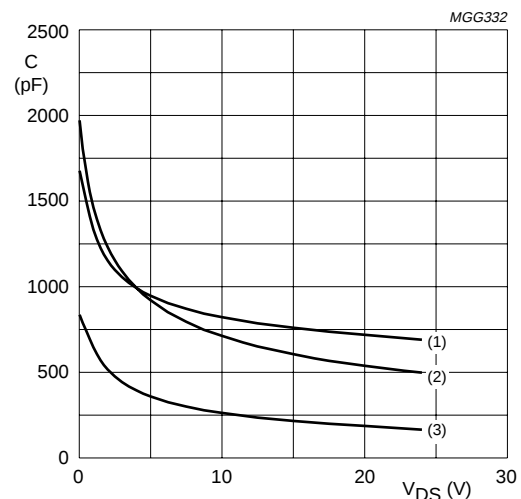


- (1) $\delta = 0.75$. (2) $\delta = 0.5$. (3) $\delta = 0.33$. (4) $\delta = 0.2$.
 (5) $\delta = 0.1$. (6) $\delta = 0.05$. (7) $\delta = 0.02$. (8) $\delta = 0.01$. (9) $\delta = 0$.

Fig.5 Transient thermal resistance from junction to soldering point as a function of pulse time; typical values.

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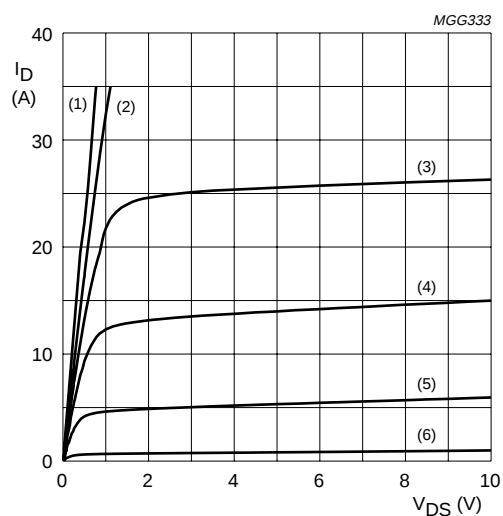
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$V_{GS} = 0$; $f = 1$ MHz; $T_j = 25$ °C.

- (1) C_{iss} .
- (2) C_{oss} .
- (3) C_{rss} .

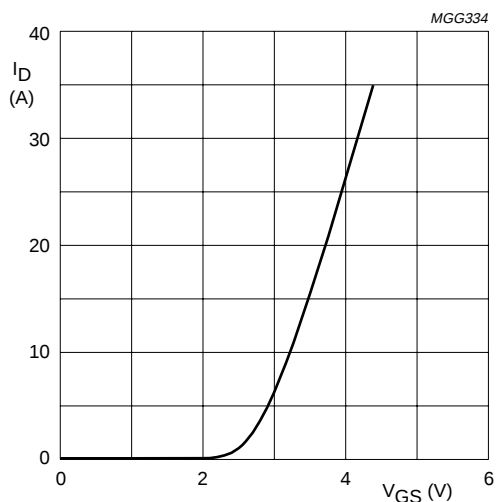
Fig.6 Capacitance as a function of drain-source voltage; typical values.



$T_j = 25$ °C.

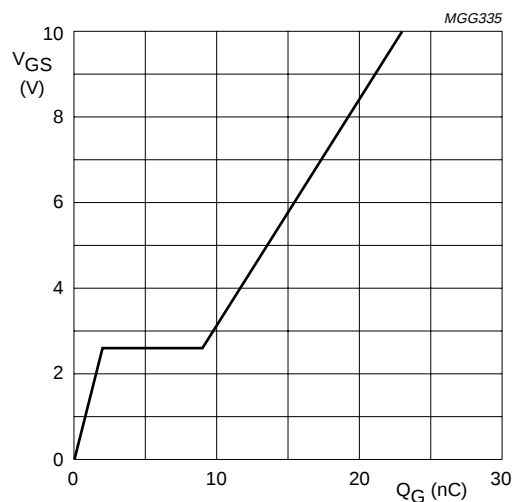
- (1) $V_{GS} = 10$ V.
- (2) $V_{GS} = 5$ V.
- (3) $V_{GS} = 4$ V.
- (4) $V_{GS} = 3.5$ V.
- (5) $V_{GS} = 3$ V.
- (6) $V_{GS} = 2.5$ V.

Fig.7 Output characteristics; typical values.



$V_{DS} = 10$ V; $T_j = 25$ °C.

Fig.8 Transfer characteristic; typical value.

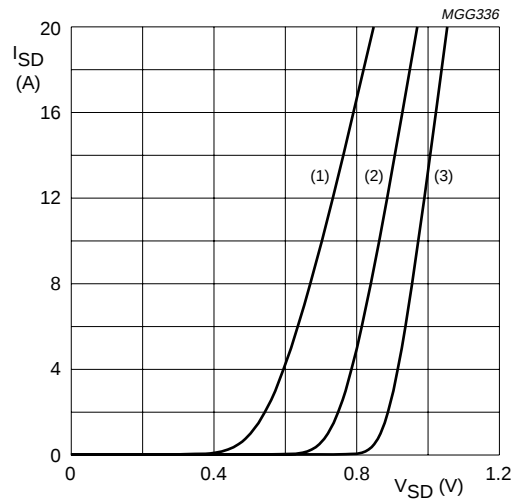


$V_{DD} = 15$ V; $I_D = 4$ A.

Fig.9 Gate-source voltage as a function of total gate charge; typical values.

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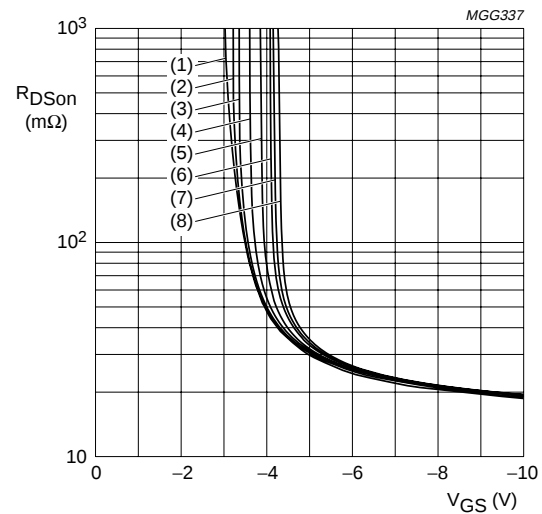
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$V_{GD} = 0$.

- (1) $T_j = 150\text{ }^{\circ}\text{C}$.
- (2) $T_j = 25\text{ }^{\circ}\text{C}$.
- (3) $T_j = -65\text{ }^{\circ}\text{C}$.

Fig.10 Source current as a function of source-drain diode forward voltage; typical values.



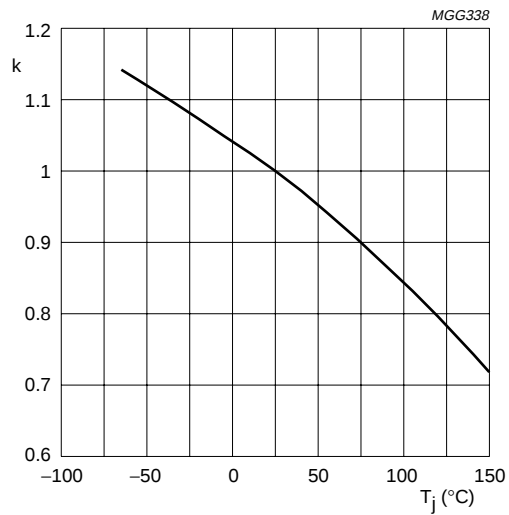
$V_{DS} \geq I_D \times R_{DS(on)}$; $T_j = 25\text{ }^{\circ}\text{C}$.

- | | |
|-----------------------------|----------------------------|
| (1) $I_D = 0.1\text{ A}$. | (5) $I_D = 5.5\text{ A}$. |
| (2) $I_D = 0.5\text{ A}$. | (6) $I_D = 8.5\text{ A}$. |
| (3) $I_D = 1.0\text{ A}$. | (7) $I_D = 10\text{ A}$. |
| (4) $I_D = 2.75\text{ A}$. | (8) $I_D = 12\text{ A}$. |

Fig.11 Drain-source on-state resistance as a function of gate-source voltage; typical values.

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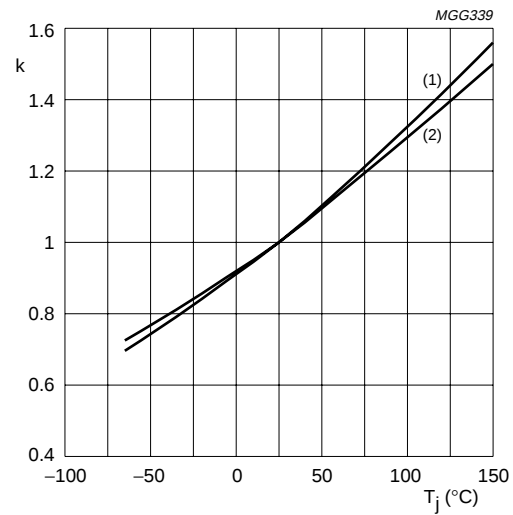
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$$k = \frac{V_{GSth} \text{ at } T_j}{V_{GSth} \text{ at } 25^\circ\text{C}}$$

V_{GSth} at $V_{DS} = V_{GS}$; $I_D = 1$ mA.

Fig.12 Temperature coefficient of gate-source threshold voltage; typical values.



$$k = \frac{R_{DSon} \text{ at } T_j}{R_{DSon} \text{ at } 25^\circ\text{C}}$$

(1) R_{DSon} at $V_{GS} = 10$ V; $I_D = 5.5$ A.

(2) R_{DSon} at $V_{GS} = 4.5$ V; $I_D = 2.75$ A.

Fig.13 Temperature coefficient of drain-source on-state resistance; typical values.

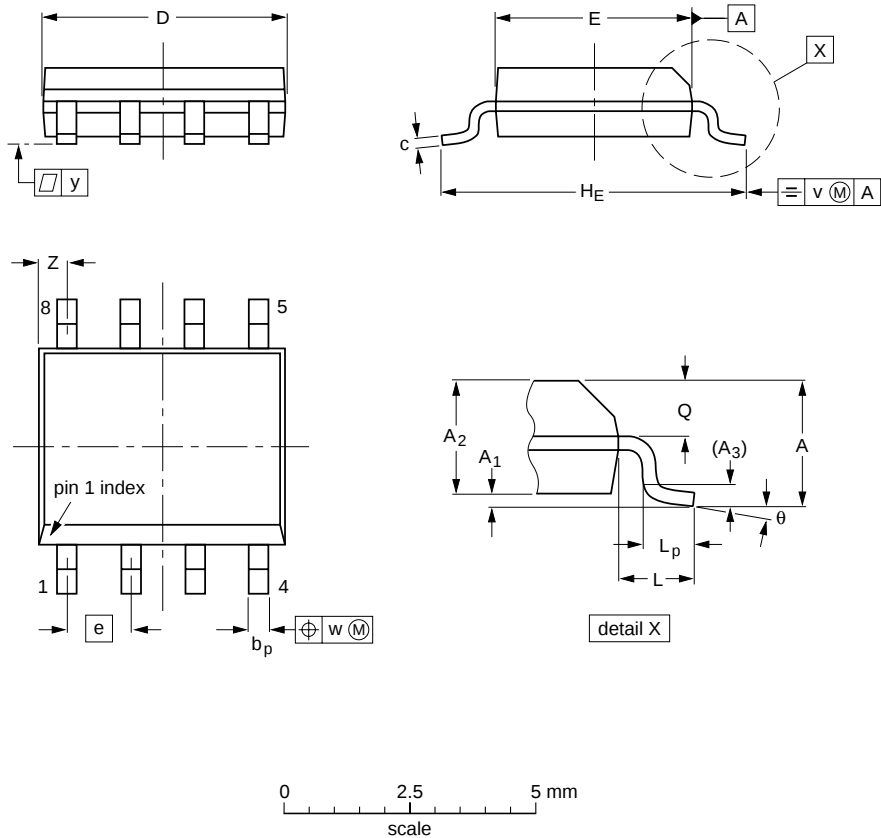
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PACKAGE OUTLINE

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽²⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Notes

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03S	MS-012AA				95-02-04 97-05-22

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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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