

DATA SHEET

PHC21025

Complementary enhancement
mode MOS transistors

Product specification
Supersedes data of November 1994
File under Discrete Semiconductors, SC13b

1997 Jun 20

Complementary enhancement mode MOS transistors

PHC21025

FEATURES

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

APPLICATIONS

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

DESCRIPTION

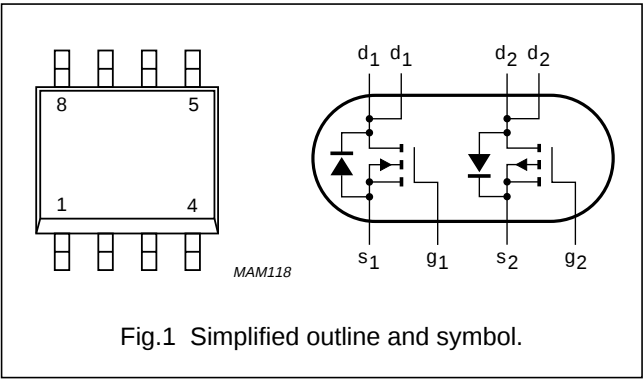
One N-channel and one P-channel enhancement mode MOS transistor in an 8-pin plastic SOT96-1 (SO8) package.

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	s ₁	source 1
2	g ₁	gate 1
3	s ₂	source 2
4	g ₂	gate 2
5	d ₂	drain 2
6	d ₂	drain 2
7	d ₁	drain 1
8	d ₁	drain 1



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per channel					
V _{DS}	drain-source voltage (DC)				
	N-channel		–	30	V
	P-channel		–	–30	V
V _{SD}	source-drain diode forward voltage				
	N-channel	I _S = 1.25 A	–	1.2	V
	P-channel	I _S = –1.25 A	–	–1.6	V
V _{GSO}	gate-source voltage (DC)	open drain	–	±20	V
V _{GStH}	gate-source threshold voltage				V
	N-channel	V _{DS} = V _{GS} ; I _D = 1 mA	1	2.8	V
	P-channel	V _{DS} = V _{GS} ; I _D = –1 mA	–1	–2.8	V
I _D	drain current (DC)				
	N-channel		–	3.5	A
	P-channel		–	–2.3	A
R _{DSon}	drain-source on-state resistance				
	N-channel	V _{GS} = 10 V; I _D = 2.2 A	–	0.1	Ω
	P-channel	V _{GS} = –10 V; I _D = –1 A	–	0.25	Ω
P _{tot}	total power dissipation	T _s = 80 °C	–	2	W

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LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per channel					
V_{DS}	drain-source voltage (DC)				
	N-channel		–	30	V
	P-channel		–	–30	V
V_{GSO}	gate-source voltage (DC)	open drain	–	±20	V
I_D	drain current (DC)	$T_s \leq 80\text{ °C}$			
	N-channel		–	3.5	A
	P-channel		–	–2.3	A
I_{DM}	peak drain current	note 1			
	N-channel		–	14	A
	P-channel		–	–10	A
P_{tot}	total power dissipation	$T_s = 80\text{ °C}$; note 2	–	2	W
		$T_{amb} = 25\text{ °C}$; note 3	–	2	W
		$T_{amb} = 25\text{ °C}$; note 4	–	1	W
		$T_{amb} = 25\text{ °C}$; note 5	–	1.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C
Source-drain diode					
I_S	source current (DC)	$T_s \leq 80\text{ °C}$			
	N-channel		–	1.5	A
	P-channel		–	–1.25	A
I_{SM}	peak pulsed source current	note 1			
	N-channel		–	6	A
	P-channel		–	–5	A

Notes

1. Pulse width and duty cycle limited by maximum junction temperature.
2. Maximum permissible dissipation per MOS transistor. Both devices may be loaded up to 2 W at the same time.
3. Maximum permissible dissipation per MOS transistor. Device mounted on printed-circuit board with an $R_{th\ a-tp}$ (ambient to tie-point) of 27.5 K/W.
4. Maximum permissible dissipation per MOS transistor. Device mounted on printed-circuit board with an $R_{th\ a-tp}$ (ambient to tie-point) of 90 K/W.
5. Maximum permissible dissipation if only one MOS transistor dissipates. Device mounted on printed-circuit board with an $R_{th\ a-tp}$ (ambient to tie-point) of 90 K/W.

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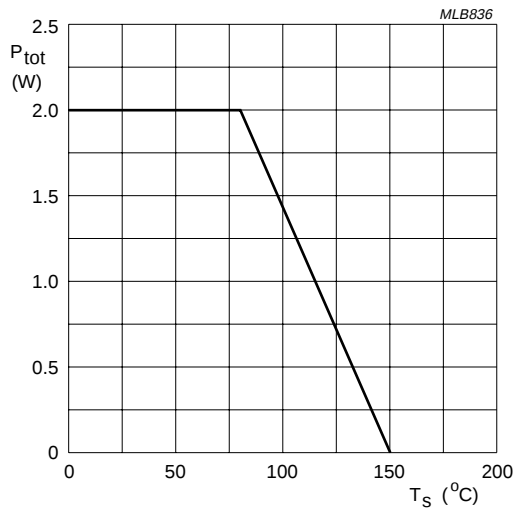
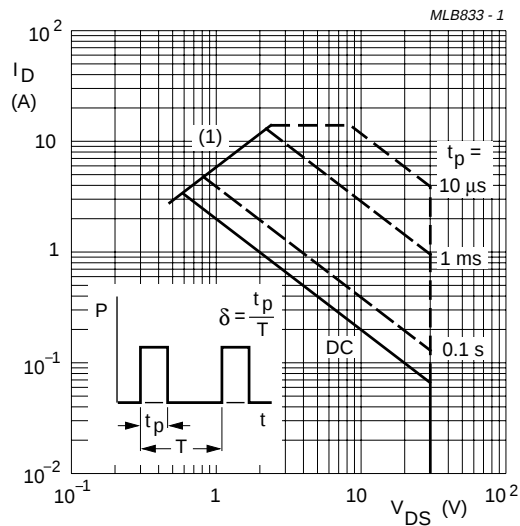
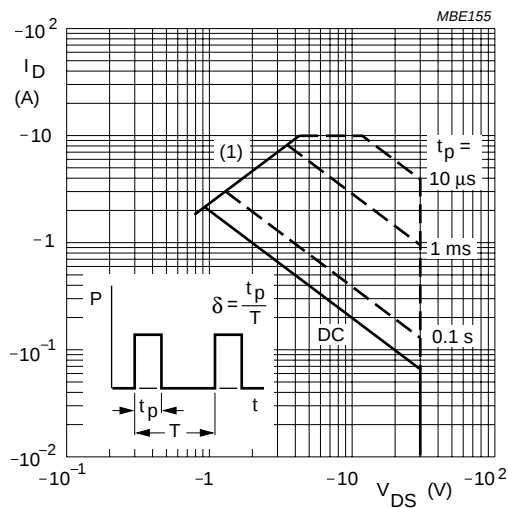


Fig.2 Power derating curve.



$\delta = 0.01$.
 $T_s = 80\text{ }^{\circ}C$.
(1) $R_{DS(on)}$ limitation.

Fig.3 SOAR; N-channel.



$\delta = 0.01$.
 $T_s = 80\text{ }^{\circ}C$.
(1) $R_{DS(on)}$ limitation.

Fig.4 SOAR; P-channel.

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THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to soldering point	35	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per channel						
$V_{(BR)DSS}$	drain-source breakdown voltage					
	N-channel	$V_{GS} = 0; I_D = 10\ \mu\text{A}$	30	–	–	V
	P-channel	$V_{GS} = 0; I_D = -10\ \mu\text{A}$	-30	–	–	V
V_{GSth}	gate-source threshold voltage					
	N-channel	$V_{GS} = V_{DS}; I_D = 1\ \text{mA}$	1	–	2.8	V
	P-channel	$V_{GS} = V_{DS}; I_D = -1\ \text{mA}$	-1	–	-2.8	V
I_{DSS}	drain-source leakage current					
	N-channel	$V_{GS} = 0; V_{DS} = 24\ \text{V}$	–	–	100	nA
	P-channel	$V_{GS} = 0; V_{DS} = -24\ \text{V}$	–	–	-100	nA
I_{GSS}	gate leakage current	$V_{GS} = \pm 20\ \text{V}; V_{DS} = 0$				
	N-channel		–	–	± 100	nA
	P-channel		–	–	± 100	nA
I_{Don}	on-state drain current					
	N-channel	$V_{GS} = 10\ \text{V}; V_{DS} = 1\ \text{V}$	3.5	–	–	A
		$V_{GS} = 4.5\ \text{V}; V_{DS} = 5\ \text{V}$	2	–	–	A
	P-channel	$V_{GS} = -10\ \text{V}; V_{DS} = -1\ \text{V}$	-2.3	–	–	A
		$V_{GS} = -4.5\ \text{V}; V_{DS} = -5\ \text{V}$	-1	–	–	A
R_{DSon}	drain-source on-state resistance					
	N-channel	$V_{GS} = 4.5\ \text{V}; I_D = 1\ \text{A}$	–	0.11	0.2	Ω
		$V_{GS} = 10\ \text{V}; I_D = 2.2\ \text{A}$	–	0.08	0.1	Ω
	P-channel	$V_{GS} = -4.5\ \text{V}; I_D = -0.5\ \text{A}$	–	0.33	0.4	Ω
		$V_{GS} = -10\ \text{V}; I_D = -1\ \text{A}$	–	0.22	0.25	Ω
$ y_{fs} $	forward transfer admittance					
	N-channel	$V_{DS} = 20\ \text{V}; I_D = 2.2\ \text{A}$	2	4.5	–	S
	P-channel	$V_{DS} = -20\ \text{V}; I_D = -1\ \text{A}$	1	2	–	S
C_{iss}	input capacitance					
	N-channel	$V_{GS} = 0; V_{DS} = 20\ \text{V}; f = 1\ \text{MHz}$	–	250	–	pF
	P-channel	$V_{GS} = 0; V_{DS} = -20\ \text{V}; f = 1\ \text{MHz}$	–	250	–	pF
C_{oss}	output capacitance					
	N-channel	$V_{GS} = 0; V_{DS} = 20\ \text{V}; f = 1\ \text{MHz}$	–	140	–	pF
	P-channel	$V_{GS} = 0; V_{DS} = -20\ \text{V}; f = 1\ \text{MHz}$	–	140	–	pF

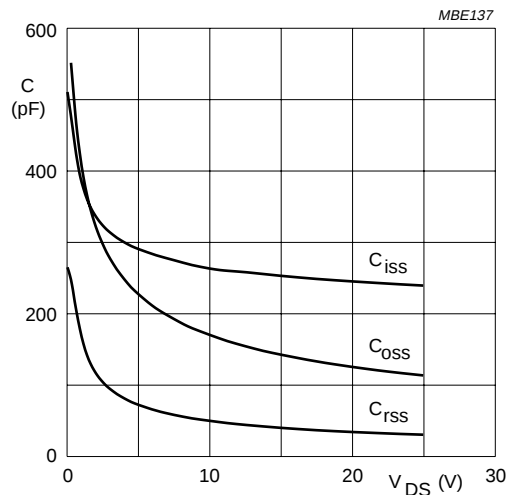
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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{rss}	reverse transfer capacitance					
	N-channel	$V_{GS} = 0$; $V_{DS} = 20$ V; $f = 1$ MHz	–	50	–	pF
	P-channel	$V_{GS} = 0$; $V_{DS} = -20$ V; $f = 1$ MHz	–	50	–	pF
Q_G	total gate charge					
	N-channel	$V_{GS} = 10$ V; $V_{DS} = 15$ V; $I_D = 2.3$ A	–	10	30	nC
	P-channel	$V_{GS} = -10$ V; $V_{DS} = -15$ V; $I_D = -2.3$ A	–	10	25	nC
Q_{GS}	gate-source charge					
	N-channel	$V_{GS} = 10$ V; $V_{DS} = 15$ V; $I_D = 2.3$ A	–	1	–	nC
	P-channel	$V_{GS} = -10$ V; $V_{DS} = -15$ V; $I_D = -2.3$ A	–	1	–	nC
Q_{GD}	gate-drain charge					
	N-channel	$V_{GS} = 10$ V; $V_{DS} = 15$ V; $I_D = 2.3$ A	–	2.5	–	nC
	P-channel	$V_{GS} = -10$ V; $V_{DS} = -15$ V; $I_D = -2.3$ A	–	3	–	nC
Switching times						
t_{on}	turn-on time					
	N-channel	$V_{GS} = 0$ to 10 V; $V_{DD} = 20$ V; $I_D = 1$ A; $R_L = 20$ Ω	–	15	40	ns
	P-channel	$V_{GS} = 0$ to -10 V; $V_{DD} = -20$ V; $I_D = -1$ A; $R_L = 20$ Ω	–	20	80	ns
t_{off}	turn-off time					
	N-channel	$V_{GS} = 10$ to 0 V; $V_{DD} = 20$ V; $I_D = 1$ A; $R_L = 20$ Ω	–	25	140	ns
	P-channel	$V_{GS} = -10$ to 0 V; $V_{DD} = -20$ V; $I_D = -1$ A; $R_L = 20$ Ω	–	50	140	ns
Source-drain diode						
V_{SD}	source-drain diode forward voltage					
	N-channel	$V_{GD} = 0$; $I_S = 1.25$ A	–	–	1.2	V
	P-channel	$V_{GD} = 0$; $I_S = -1.25$ A	–	–	-1.6	V
t_{rr}	reverse recovery time					
	N-channel	$I_S = 1.25$ A; $di/dt = 100$ A/ μ s	–	35	100	ns
	P-channel	$I_S = -1.25$ A; $di/dt = 100$ A/ μ s	–	150	200	ns

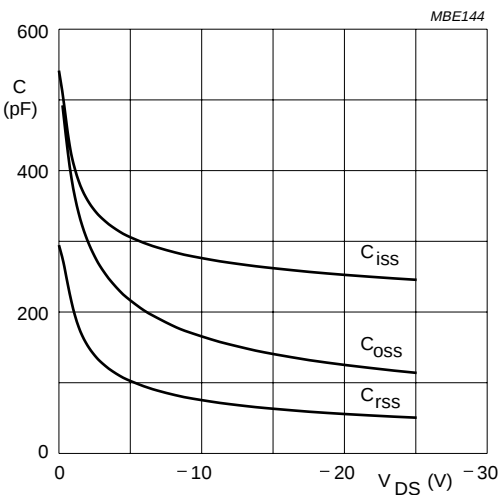
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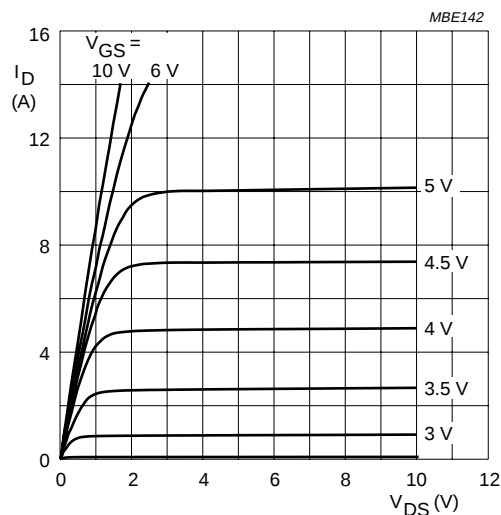
$V_{GS} = 0$.
 $T_j = 25^\circ\text{C}$.

Fig.5 Capacitance as a function of drain-source voltage; N-channel; typical values.



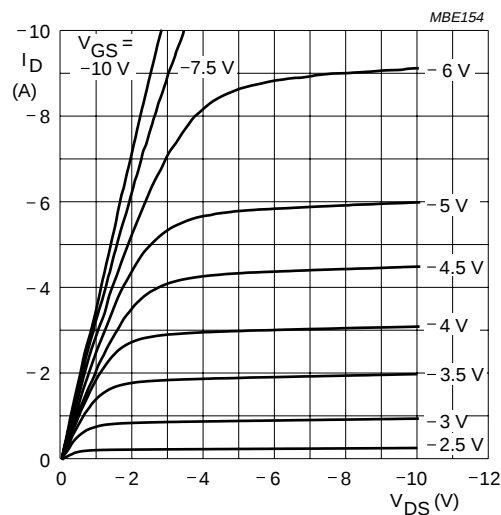
$V_{GS} = 0$.
 $T_j = 25^\circ\text{C}$.

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



$T_j = 25^\circ\text{C}$.

Fig.7 Output characteristics; typical values; N-channel.

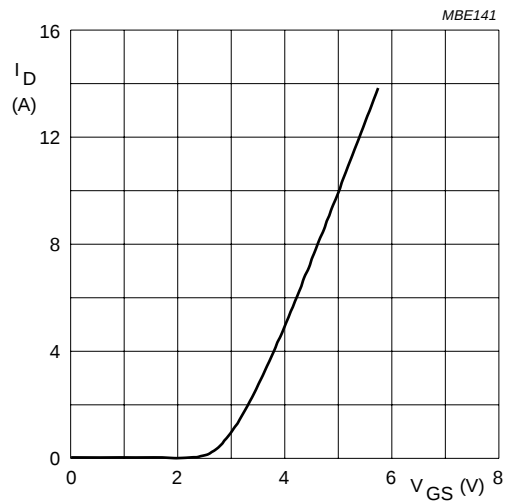


$T_j = 25^\circ\text{C}$.

Fig.8 Output characteristics; typical values; P-channel.

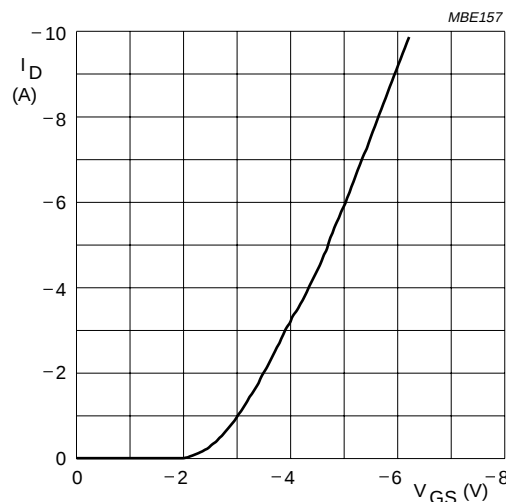
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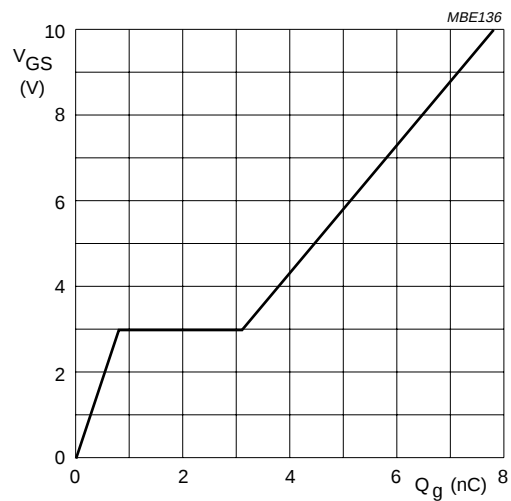
$V_{DS} = 10$ V.
 $T_j = 25$ °C.

Fig.9 Transfer characteristic; typical values;
N-channel.



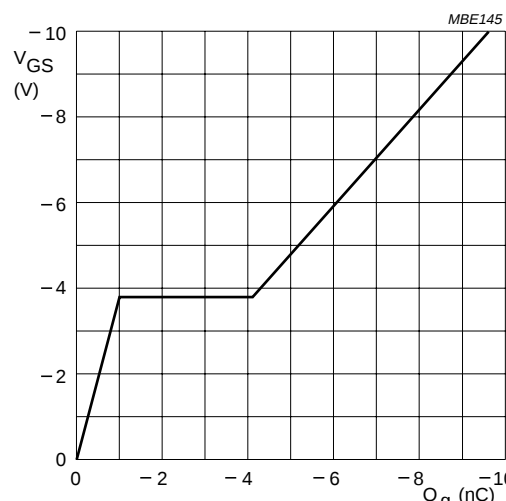
$V_{DS} = -10$ V.
 $T_j = 25$ °C.

Fig.10 Transfer characteristic; typical values;
P-channel.



$V_{DD} = 15$ V.
 $I_D = 3.5$ A.

Fig.11 Gate-source voltage as a function of total
gate charge; N-channel.

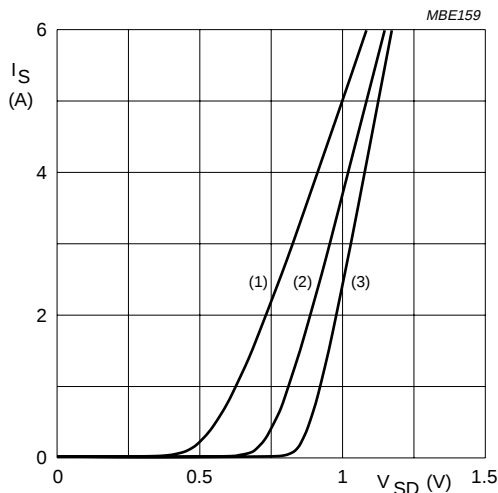


$V_{DD} = -15$ V.
 $I_D = -2.3$ A.

Fig.12 Gate-source voltage as a function of total
gate charge; P-channel.

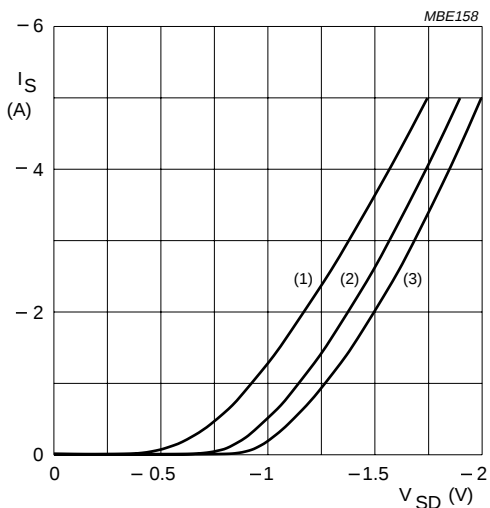
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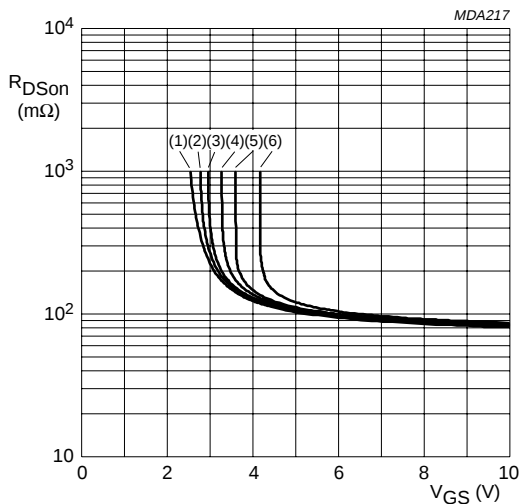
$V_{GD} = 0$.
(1) $T_J = 150\text{ }^{\circ}\text{C}$.
(2) $T_J = 25\text{ }^{\circ}\text{C}$.
(3) $T_J = -55\text{ }^{\circ}\text{C}$.

Fig.13 Source current as a function of source-drain diode forward voltage; N-channel.



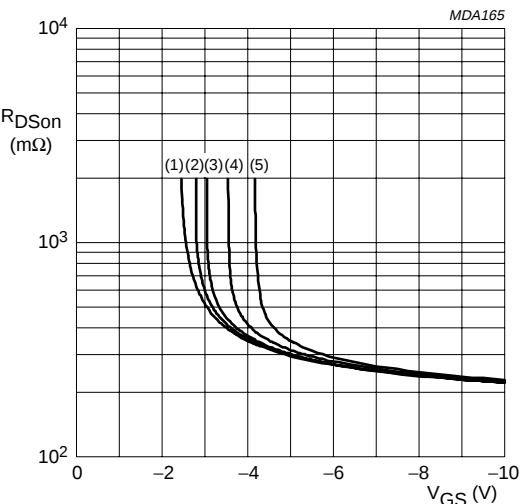
$V_{GD} = 0$.
(1) $T_J = 150\text{ }^{\circ}\text{C}$.
(2) $T_J = 25\text{ }^{\circ}\text{C}$.
(3) $T_J = -55\text{ }^{\circ}\text{C}$.

Fig.14 Source current as a function of source-drain diode forward voltage; P-channel.



$V_{DS} \geq I_D \times R_{DS(on)}$; $T_J = 25\text{ }^{\circ}\text{C}$.
(1) $I_D = 0.1\text{ A}$.
(2) $I_D = 0.5\text{ A}$.
(3) $I_D = 1\text{ A}$.
(4) $I_D = 2.2\text{ A}$.
(5) $I_D = 3.5\text{ A}$.
(6) $I_D = 7\text{ A}$.

Fig.15 Drain-source on-state resistance as a function of gate-source voltage; typical values; N-channel.

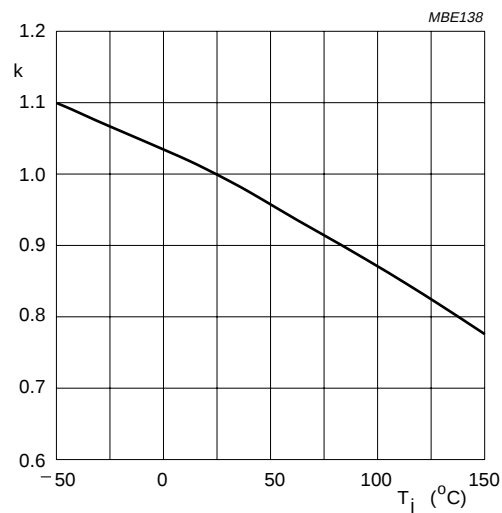


$-V_{DS} \geq -I_D \times R_{DS(on)}$; $T_J = 25\text{ }^{\circ}\text{C}$.
(1) $I_D = -0.1\text{ A}$.
(2) $I_D = -0.5\text{ A}$.
(3) $I_D = -1\text{ A}$.
(4) $I_D = -2.3\text{ A}$.
(5) $I_D = -4.5\text{ A}$.

Fig.16 Drain-source on-state resistance as a function of gate-source voltage; typical values; P-channel.

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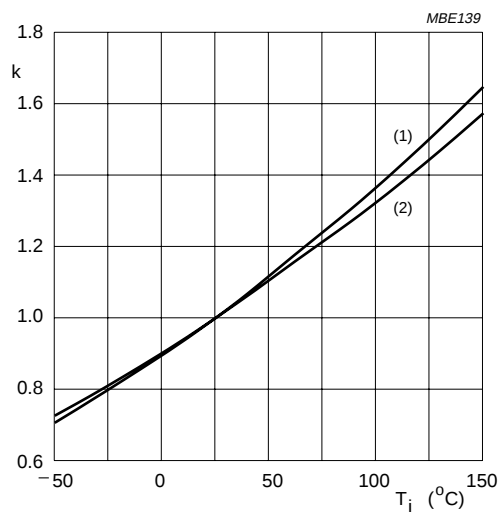
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$$k = \frac{V_{GSth} \text{ at } T_j}{V_{GSth} \text{ at } 25^\circ\text{C}}$$

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

Fig.17 Temperature coefficient of gate-source threshold voltage; N and P-channels.

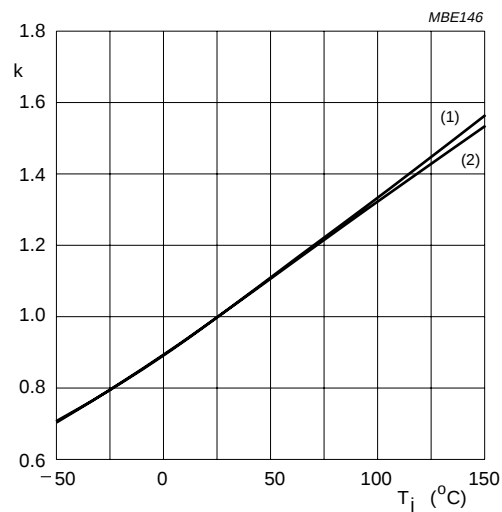


$$k = \frac{R_{DSon} \text{ at } T_j}{R_{DSon} \text{ at } 25^\circ\text{C}}$$

Typical R_{DSon} at:

- (1) $I_D = 2.2 \text{ A}$; $V_{GS} = 10 \text{ V}$.
- (2) $I_D = 1 \text{ A}$; $V_{GS} = 4.5 \text{ V}$.

Fig.18 Temperature coefficient of drain-source on-resistance; N-channel.



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

Typical R_{DSon} at:

- (1) $I_D = -1 \text{ A}$; $V_{GS} = -10 \text{ V}$.
- (2) $I_D = -0.5 \text{ A}$; $V_{GS} = -4.5 \text{ V}$.

Fig.19 Temperature coefficient of drain-source on-resistance; P-channel.

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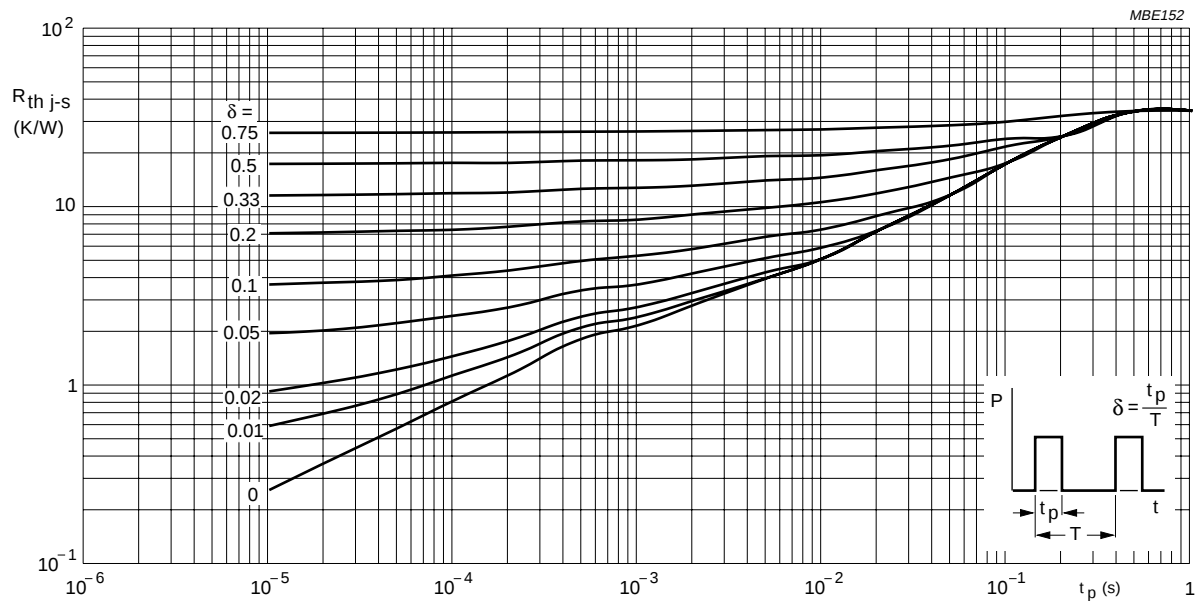


Fig.20 Transient thermal resistance from junction to soldering point as a function of pulse time; typical values.

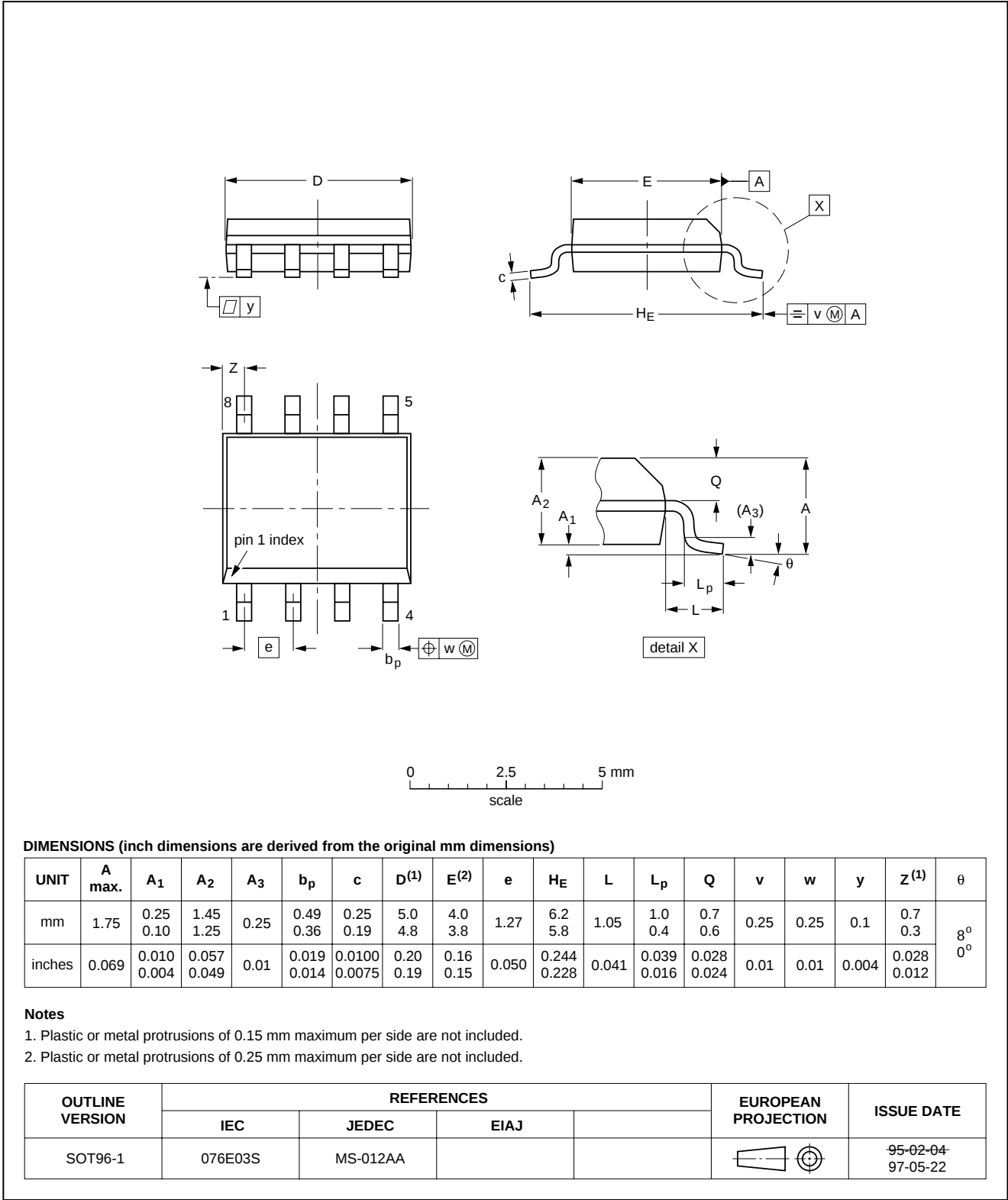
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PACKAGE OUTLINE

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

SOT96-1



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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.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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NOTES

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NOTES

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