

BUK7905-40AI

TrenchPLUS standard level FET

Rev. 01 — 9 February 2004

Product data

1. Product profile

1.1 Description

N-channel enhancement mode field-effect power transistor in a plastic package using TrenchMOS™ technology, featuring very low on-state resistance and TrenchPLUS current sensing.

1.2 Features

- Integrated current sensor
- Standard level compatible.

1.3 Applications

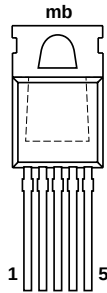
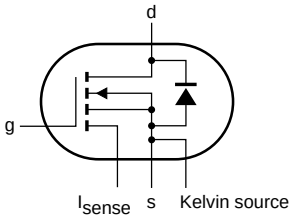
- Variable Valve Timing for engines
- Electrical Power Assisted Steering.

1.4 Quick reference data

- $V_{DS} \leq 40 \text{ V}$
- $R_{DS(on)} = 4.5 \text{ m}\Omega$ (typ)
- $I_D \leq 155 \text{ A}$
- $I_D/I_{sense} = 500$ (typ).

2. Pinning information

Table 1: Pinning - SOT263B simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	I_{sense} (I_s)		
3	drain (d)		
4	Kelvin source		
5	source (s)		
mb	mounting base; connected to drain (d)		03nl64



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3. Ordering information

Table 2: Ordering information

Type number	Package		
	Name	Description	Version
BUK7905-40AI	D ² -PAK	Plastic single ended package; heatsink mounted; 1 mounting hole; 5-lead TO-220	SOT263B

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 (DC)		-	40	V
V_{DGR}	drain-gate voltage (DC)	$R_{GS} = 20\text{ k}\Omega$	-	40	V
V_{GS}	gate-source voltage (DC)		-	± 20	V
I_D	drain current (DC)	$T_{mb} = 25\text{ }^\circ\text{C}$; $V_{GS} = 10\text{ V}$; Figure 2 and 3	[1] -	155	A
			[2] -	75	A
		$T_{mb} = 100\text{ }^\circ\text{C}$; $V_{GS} = 10\text{ V}$; Figure 2	[2] -	75	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ }^\circ\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Figure 3	-	620	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ }^\circ\text{C}$; Figure 1	-	272	W
T_{stg}	storage temperature		-55	+175	$^\circ\text{C}$
T_j	junction temperature		-55	+175	$^\circ\text{C}$

Source-drain diode

I_{DR}	reverse drain current (DC)	$T_{mb} = 25\text{ }^\circ\text{C}$	[1] -	155	A
			[2] -	75	A
I_{DRM}	peak reverse drain current	$T_{mb} = 25\text{ }^\circ\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	620	A

Avalanche ruggedness

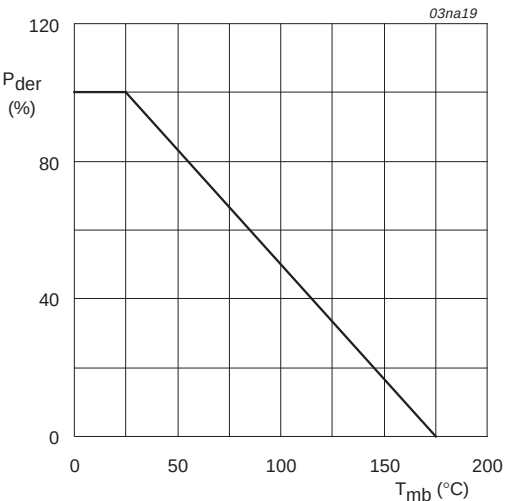
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 75\text{ A}$; $V_{DS} \leq 40\text{ V}$; $V_{GS} = 10\text{ V}$; $R_{GS} = 50\text{ }\Omega$; starting $T_j = 25\text{ }^\circ\text{C}$	-	1.46	J
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Electrostatic discharge

V_{esd}	electrostatic discharge voltage; all pins	Human Body Model; $C = 100\text{ pF}$; $R = 1.5\text{ k}\Omega$	-	4	kV
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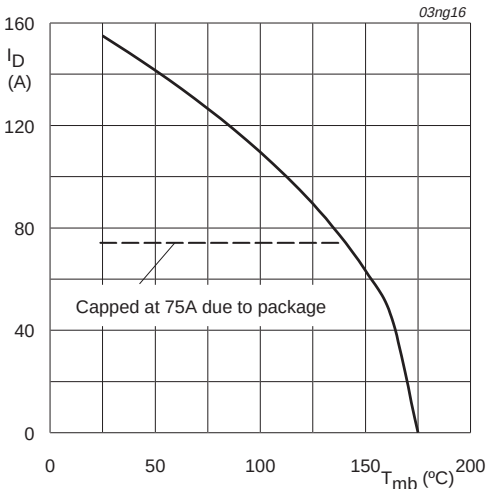
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.



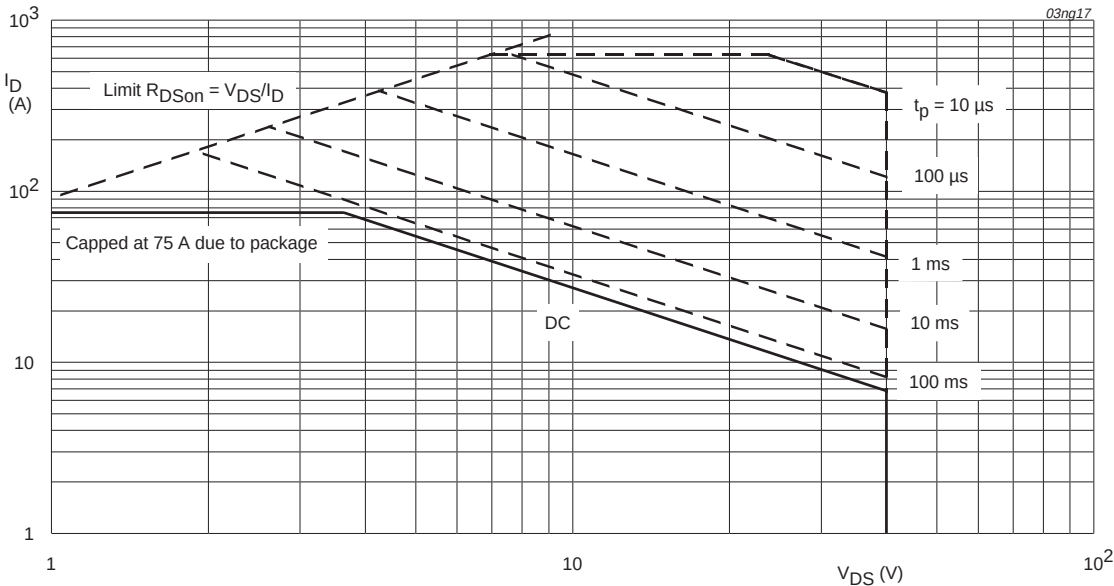
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

Fig 1. Normalized total power dissipation as a function of mounting base temperature.



$V_{GS} \geq 10$ V

Fig 2. Continuous drain current as a function of mounting base temperature.



$T_{mb} = 25$ °C; I_{DM} 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
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air				
	SOT263B		-	60	-	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	0.55	K/W

5.1 Transient thermal impedance

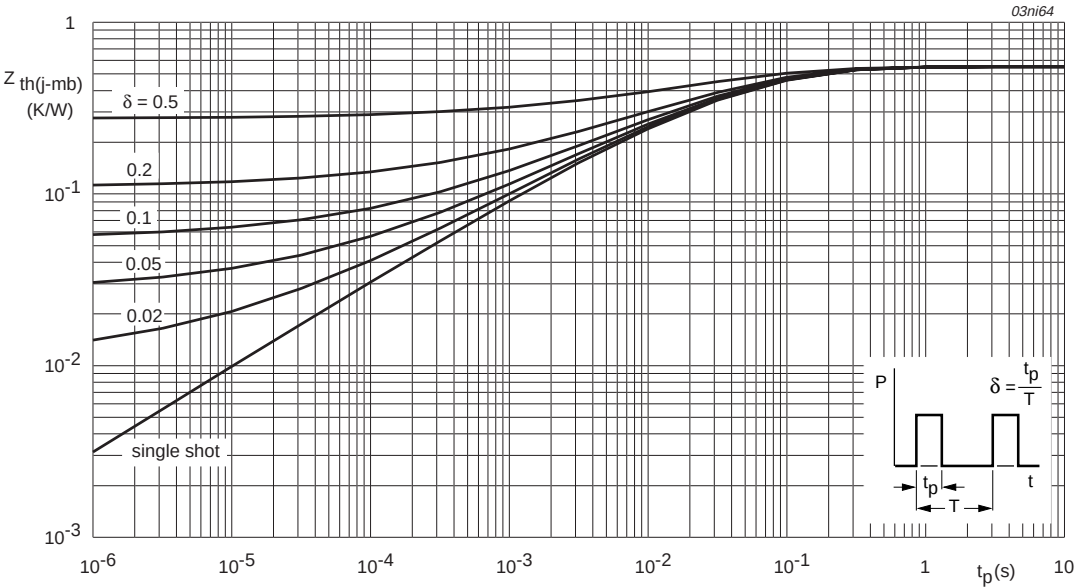


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

6. Characteristics

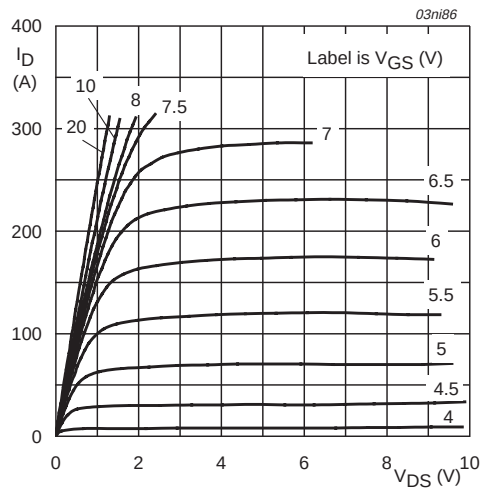
Table 5: Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25\text{ mA}$; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ }^{\circ}\text{C}$	40	-	-	V
		$T_j = -55\text{ }^{\circ}\text{C}$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$; Figure 9				
		$T_j = 25\text{ }^{\circ}\text{C}$	2	3	4	V
		$T_j = 175\text{ }^{\circ}\text{C}$	1	-	-	V
		$T_j = -55\text{ }^{\circ}\text{C}$	-	-	4.4	V
I_{DSS}	drain-source leakage current	$V_{DS} = 40\text{ V}$; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ }^{\circ}\text{C}$	-	0.1	10	μA
		$T_j = 175\text{ }^{\circ}\text{C}$	-	-	500	μA
I_{GSS}	gate-source leakage current	$V_{GS} = \pm 20\text{ V}$; $V_{DS} = 0\text{ V}$				
		$T_j = 25\text{ }^{\circ}\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 50\text{ A}$; Figure 7 and 8				
		$T_j = 25\text{ }^{\circ}\text{C}$	-	4.5	5	m Ω
		$T_j = 175\text{ }^{\circ}\text{C}$	-	-	9.5	m Ω
$R_{D(I_s)on}$	drain- I_{sense} on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ mA}$; Figure 16				
		$T_j = 25\text{ }^{\circ}\text{C}$	0.98	1.08	1.18	Ω
		$T_j = 175\text{ }^{\circ}\text{C}$	1.86	2.05	2.24	Ω
I_D/I_{sense}	ratio of drain current to sense current	$V_{GS} > 10\text{ V}$; $R_{sense} = 0\text{ }\Omega$; $-55\text{ }^{\circ}\text{C} < T_j < 175\text{ }^{\circ}\text{C}$	450	500	550	
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	$V_{GS} = 10\text{ V}$; $V_{DS} = 32\text{ V}$; $I_D = 25\text{ A}$; Figure 14	-	120	127	nC
Q_{gs}	gate-source charge		-	19	22	nC
Q_{gd}	gate-drain (Miller) charge		-	50	60	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$; $f = 1\text{ MHz}$; Figure 12	-	4300	5000	pF
C_{oss}	output capacitance		-	1400	1670	pF
C_{rss}	reverse transfer capacitance		-	820	1100	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30\text{ V}$; $R_L = 1.2\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $R_G = 10\text{ }\Omega$	-	35	-	nS
t_r	rise time		-	115	-	nS
$t_{d(off)}$	turn-off delay time		-	155	-	nS
t_f	fall time		-	110	-	nS
L_d	internal drain inductance	measured from upper edge of drain mounting base to center of die	-	2.5	-	nH
L_s	internal source inductance	measured from source lead to source bond pad	-	7.5	-	nH

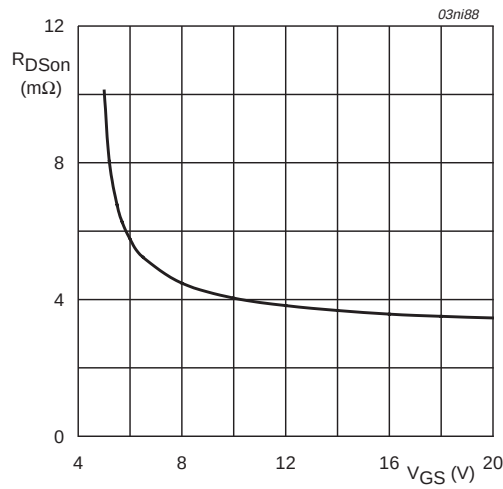
Table 5: Characteristics...continued
 $T_j = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	$I_S = 40\text{ A}$; $V_{GS} = 0\text{ V}$; Figure 17	-	0.85	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$	-	96	-	ns
Q_r	recovered charge	$V_{GS} = -10\text{ V}$; $V_{DS} = 30\text{ V}$	-	224	-	nC



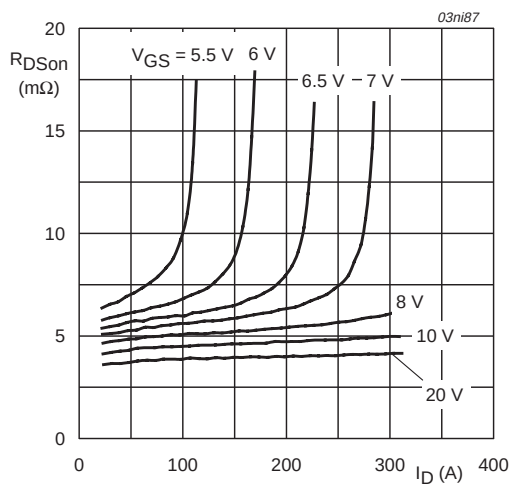
$T_j = 25\text{ }^{\circ}\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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



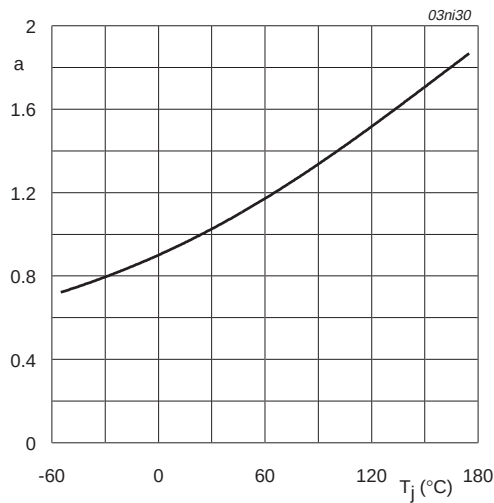
$T_j = 25\text{ }^{\circ}\text{C}$; $I_D = 50\text{ A}$

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



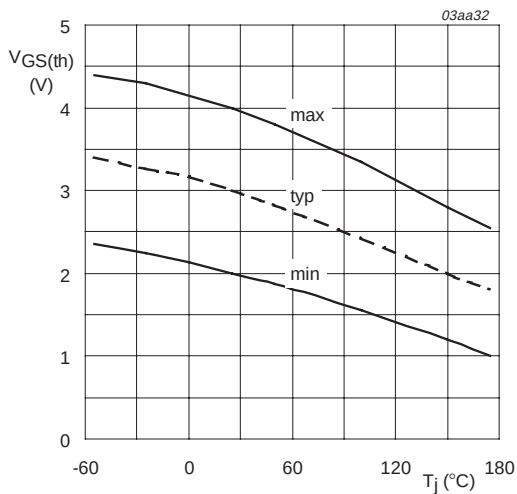
$T_j = 25\text{ }^{\circ}\text{C}$; $t_p = 300\text{ }\mu\text{s}$

Fig 7. Drain-source on-state resistance as a function of drain current; typical values.



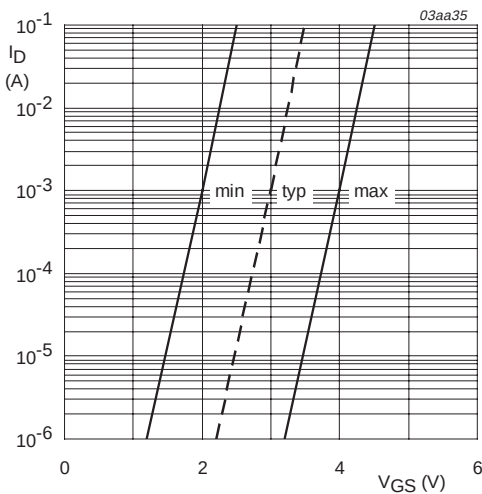
$$a = \frac{R_{DSon}}{R_{DSon(25^{\circ}\text{C})}}$$

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



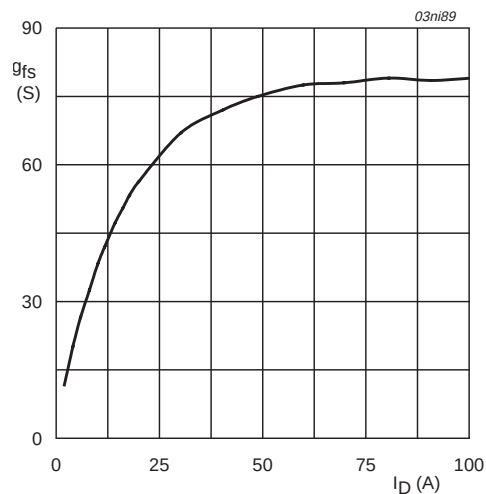
$I_D = 1 \text{ mA}$; $V_{DS} = V_{GS}$

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



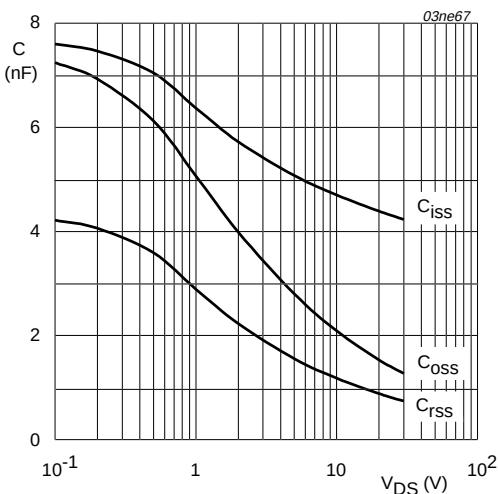
$T_j = 25 \text{ °C}$; $V_{DS} = V_{GS}$

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



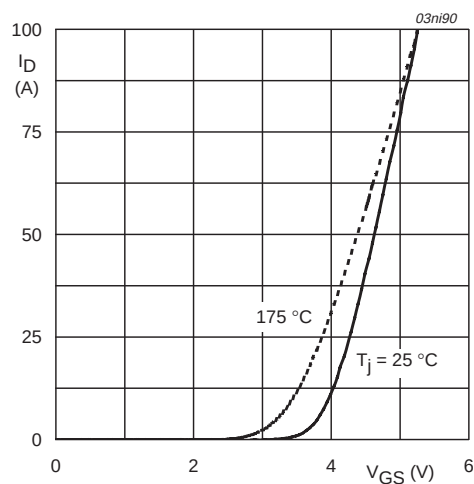
$T_j = 25 \text{ °C}$; $V_{DS} = 25 \text{ V}$

Fig 11. Forward transconductance as a function of drain current; typical values.



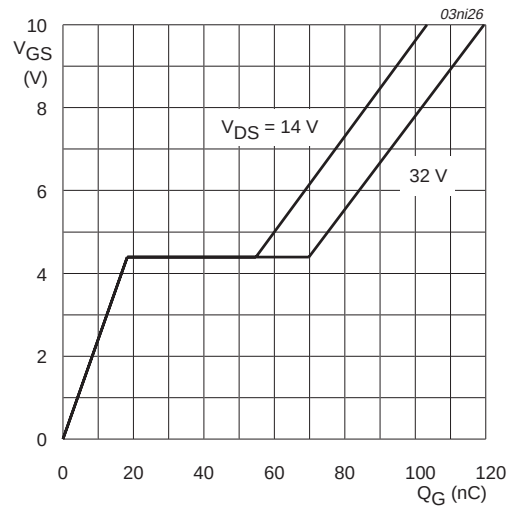
$V_{GS} = 0 \text{ V}$; $f = 1 \text{ MHz}$

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



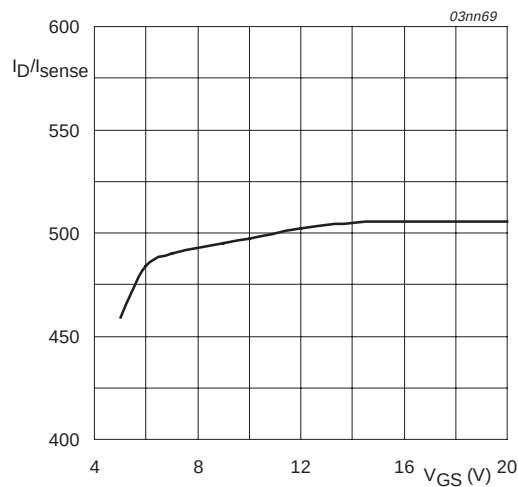
$V_{DS} = 25\text{ V}$

Fig 13. Transfer characteristics: drain current as a function of gate-source voltage; typical values.



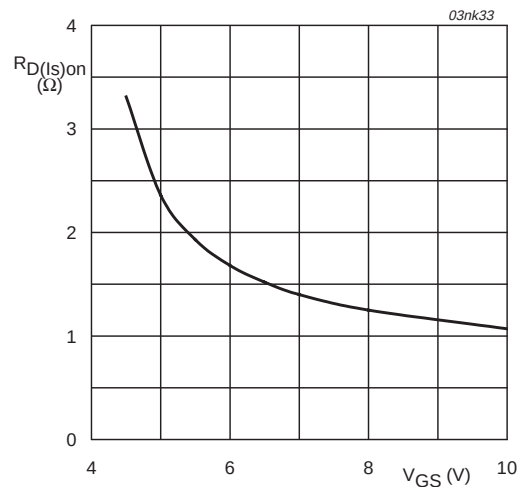
$T_j = 25\text{ °C}; I_D = 25\text{ A}$

Fig 14. Gate-source voltage as a function of turn-on gate charge; typical values.



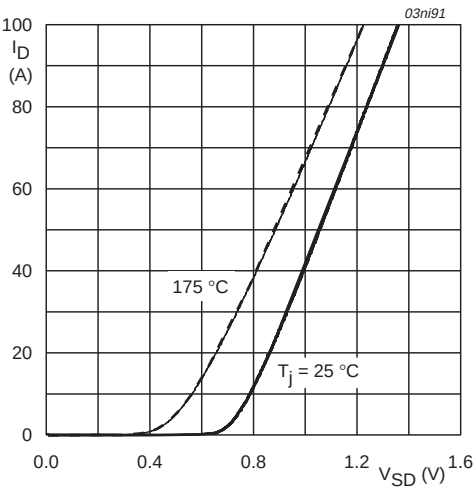
$I_D = 50\text{ A}; R_{sense} = 0\text{ }\Omega$

Fig 15. Drain-sense current ratio as a function of gate-source voltage; typical values.



$I_{sense} = 25\text{ mA}$

Fig 16. Drain- I_{sense} on-state resistance as function of gate-source voltage; typical values.



$V_{GS} = 0$ V

Fig 17. Drain current as a function of source-drain diode voltage; typical values.

7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 5-lead TO-220

SOT263B

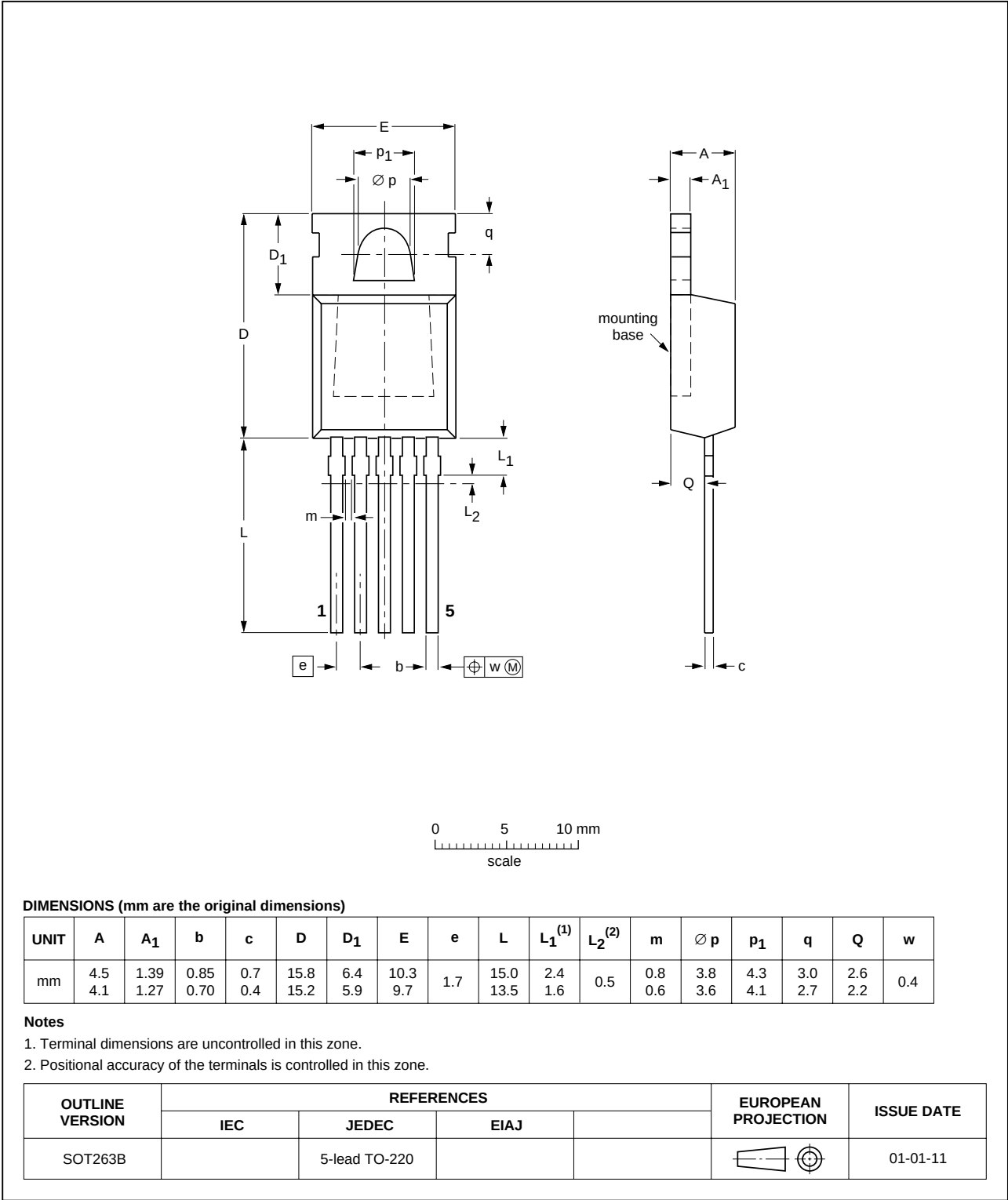


Fig 18. SOT263B (TO-220).

8. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20040209	-	Product data; initial version

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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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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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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