BUK71/7907-40ATC

TrenchPLUS standard level FET

Rev. 01 — 9 August 2002 **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, TrenchPLUS diodes for clamping, (ESD) protection and temperature sensing.

Product availability:

BUK7107-40ATC in SOT426 (D^2-PAK)

BUK7907-40ATC in SOT263B (TO-220AB).

1.2 Features

- Integrated temperature sensor
- ESD and overvoltage protection
- Q101 compliant
- R_{DSon} = 5.8 mΩ (typ).

1.3 Applications

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

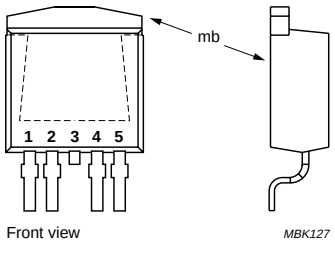
1.4 Quick reference data

- $V_{DS} \leq 40$ V
- $I_D \leq 75$ A
- V_F = 658 mV (typ)
- S_F = –1.54 mV/K (typ).

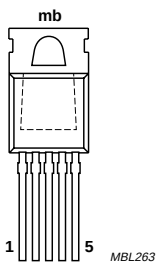
2. Pinning information

Table 1: Pinning - SOT426 and SOT263B, simplified outline and symbol

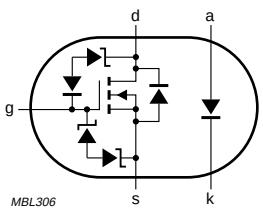
Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	anode (a)		
3	drain (d)		
4	cathode (k)		
5	source (s)		
mb	mounting base; connected to drain (d)		



SOT426 (D^2-PAK)



SOT263B (TO-220AB)



3. Limiting values

Table 2: Limiting values

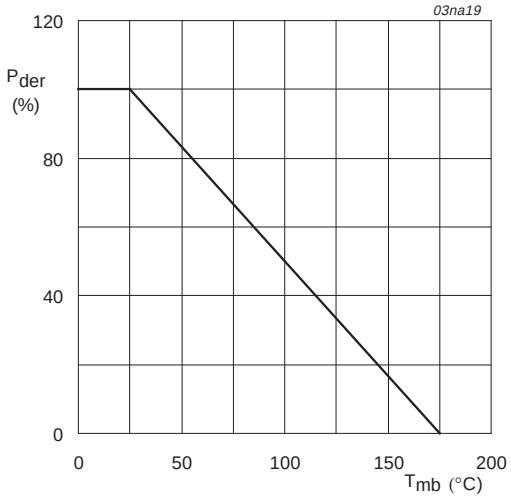
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage (DC)		[1]	-	40	V
V_{DGS}	drain-gate voltage (DC)	I_{DG} = 250 µA	[1]	-	40	V
V_{GS}	gate-source voltage (DC)			-	±20	V
I_D	drain current (DC)	T_{mb} = 25 °C; V_{GS} = 10 V; Figure 2 and 3	[2]	-	140	A
			[3]	-	75	A
		T_{mb} = 100 °C; V_{GS} = 10 V; Figure 2	[3]	-	75	A
I_{DM}	peak drain current	T_{mb} = 25 °C; pulsed; $t_p \leq 10$ µs; Figure 3		-	560	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Figure 1		-	272	W
$I_{DG(CL)}$	drain-gate clamping current	t_p = 5 ms; δ = 0.01		-	50	mA
$I_{GS(CL)}$	gate-source clamping current	continuous		-	10	mA
		t_p = 5 ms; δ = 0.01		-	50	mA
$V_{isol(FET-TSD)}$	FET to temperature sense diode isolation voltage			-	±100	V
T_{stg}	storage temperature			–55	+175	°C
T_j	junction temperature			–55	+175	°C
Source-drain diode						
I_{DR}	reverse drain current	T_{mb} = 25 °C	[2]	-	140	A
			[3]	-	75	A
I_{DRM}	peak reverse drain current	T_{mb} = 25 °C; pulsed; $t_p \leq 10$ µs		-	560	A
Clamping						
$E_{DS(CL)S}$	non-repetitive drain-source clamping energy	unclamped inductive load; I_D = 75 A; $V_{DS} \leq 40$ V; V_{GS} = 10 V; R_{GS} = 10 kΩ; starting T_j = 25 °C		-	1.4	J
Electrostatic Discharge						
V_{esd}	electrostatic discharge voltage; pins 1,3,5	Human Body Model; C = 100 pF; R = 1.5 kΩ			6	kV

[1] Voltage is limited by clamping

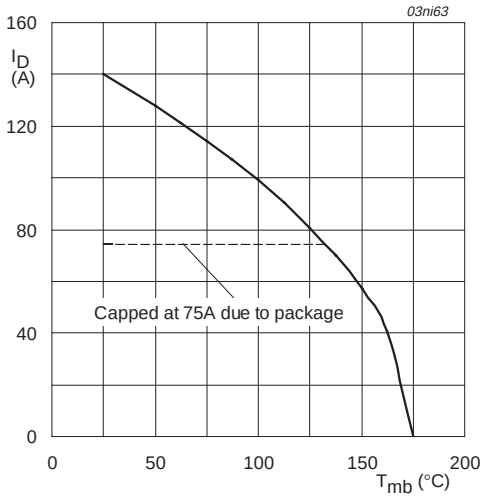
[2] Current is limited by power dissipation chip rating

[3] Continuous current is limited by package.



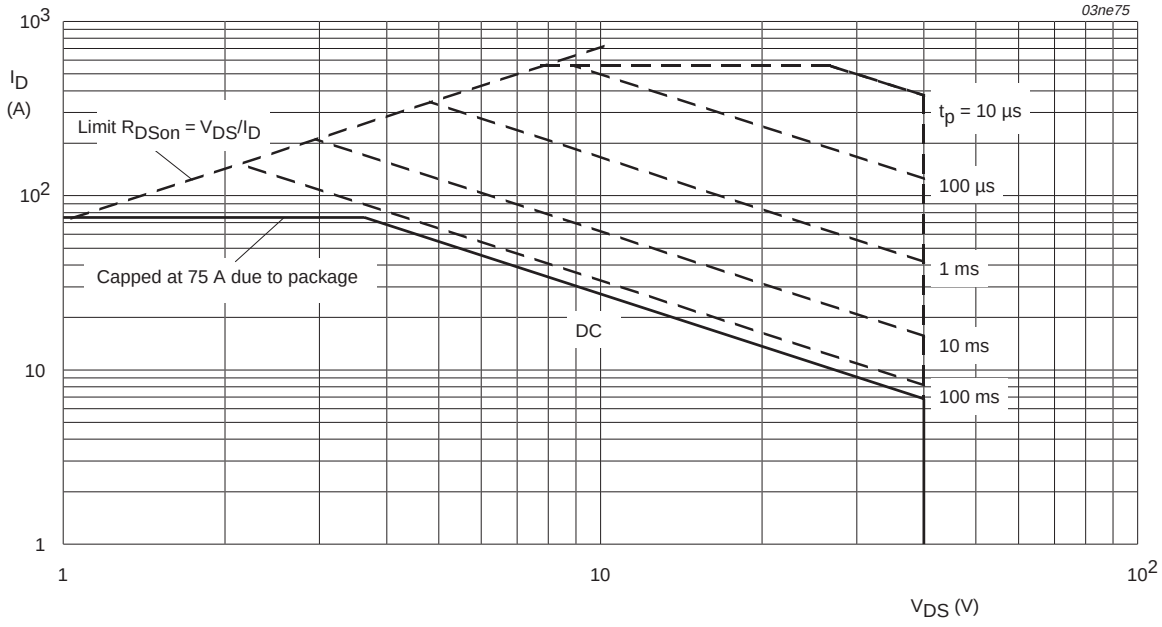
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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.

4. Thermal characteristics

Table 3: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient					
	SOT263B	vertical in still air	-	60	-	K/W
	SOT426	minimum footprint; mounted on a PCB	-	50	-	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	0.55	K/W

4.1 Transient thermal impedance

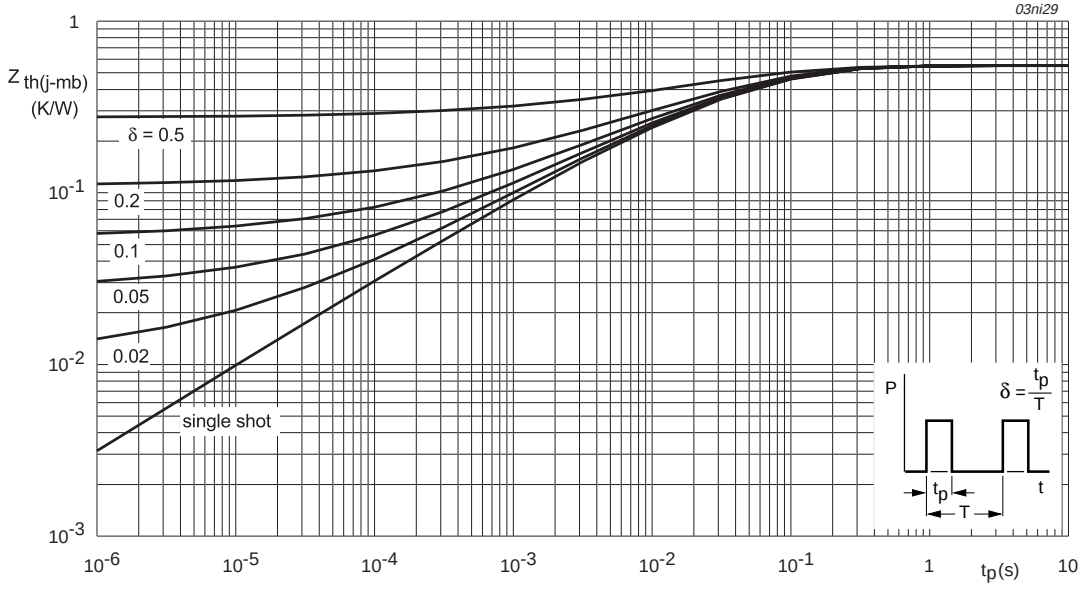


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

5. Characteristics

Table 4: Characteristics

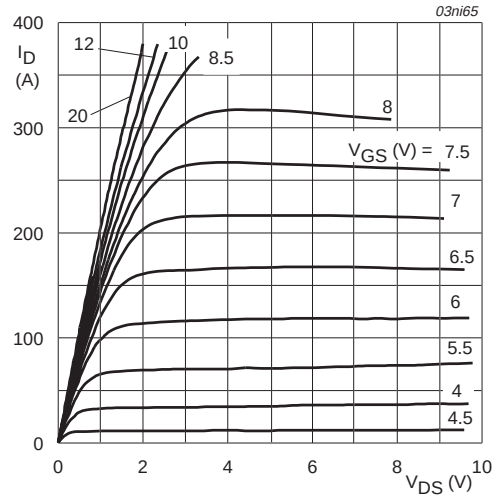
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DG}$	drain-gate zener breakdown voltage	I_D = 0.25 mA; V_{GS} = 0 V				
		T_j = 25°C	40	-	-	V
		T_j = –55 °C	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; Figure 9				
		T_j = 25°C	2	3	4	V
		T_j = 175 °C	1	-	-	V
		T_j = –55 °C	-	-	4.4	V
I_{DSS}	drain-source leakage current	V_{DS} = 40 V; V_{GS} = 0 V				
		T_j = 25°C	-	0.1	10	µA
		T_j = 175 °C	-	-	250	µA
$V_{(BR)GSS}$	gate-source breakdown voltage	I_G = ±1 mA; –55°C < T_j <175 °C	20	22	-	V
I_{GSS}	gate-source leakage current	V_{GS} = ±10 V; V_{DS} = 0 V				
		T_j = 25 °C	-	5	1000	nA
		T_j = 175 °C	-	-	10	µA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 50 A; Figure 7 and 8				
		T_j = 25°C	-	5.8	7	mΩ
		T_j = 175 °C	-	-	14	mΩ
V_F	temperature sense diode forward voltage	I_F = 250 µA	648	658	668	mV
S_F	temperature sense diode temperature coefficient	I_F = 250 µA; –55°C < T_j <175 °C	–1.4	–1.54	–1.68	mV/K
V_{hys}	temperature sense diode forward voltage hysteresis	125 µA < I_F < 250 µA	25	32	50	mV
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	V_{GS} = 10 V; V_{DS} = 32 V; I_D = 25 A; Figure 14	-	108	-	nC
Q_{gs}	gate-source charge		-	21	-	nC
Q_{gd}	gate-to-drain (Miller) charge		-	42	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; Figure 12	-	4500	-	pF
C_{oss}	output capacitance		-	960	-	pF
C_{rss}	reverse transfer capacitance		-	510	-	pF
$t_{d(on)}$	turn-on delay time	V_{DD} = 30 V; R_L = 1.2 Ω; V_{GS} = 10 V; R_G = 1 kΩ	-	2	-	µs
t_r	rise time		-	5.7	-	µs
$t_{d(off)}$	turn-off delay time		-	8.9	-	µs
t_f	fall time		-	6.8	-	µs

Table 4: Characteristics...*continued*

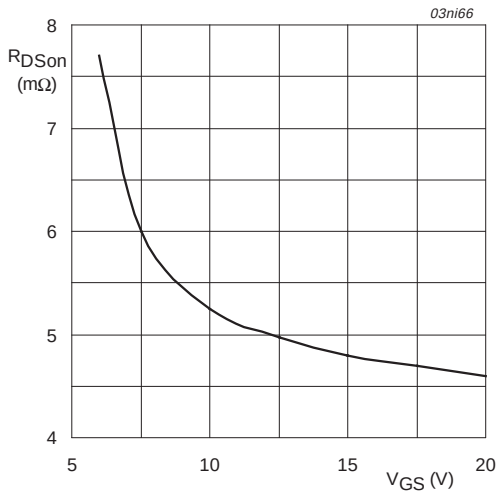
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
L_d	internal drain inductance	from upper edge of drain mounting base to center of die	-	2.5	-	nH
L_s	internal source inductance	from source lead to source bond pad	-	7.5	-	nH
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	I_S = 25 A; V_{GS} = 0 V; Figure 19	-	0.85	1.2	V
t_{rr}	reverse recovery time	I_S = 20 A; dI_S/dt = –100 A/µs V_{GS} = –10 V; V_{DS} = 30 V	-	80	-	ns
Q_r	recovered charge		-	200	-	nC



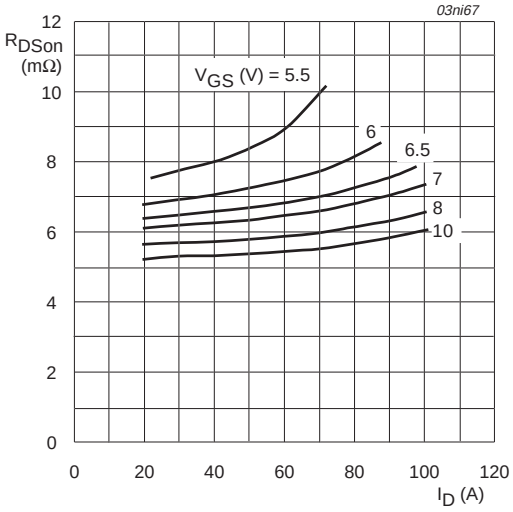
T_j = 25 °C; t_p = 300 µs

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



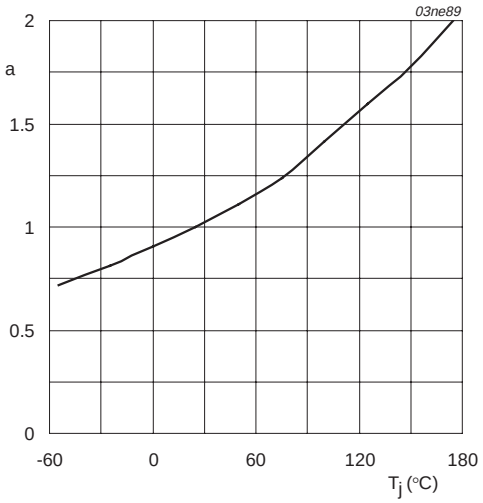
T_j = 25 °C; I_D = 50 A

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



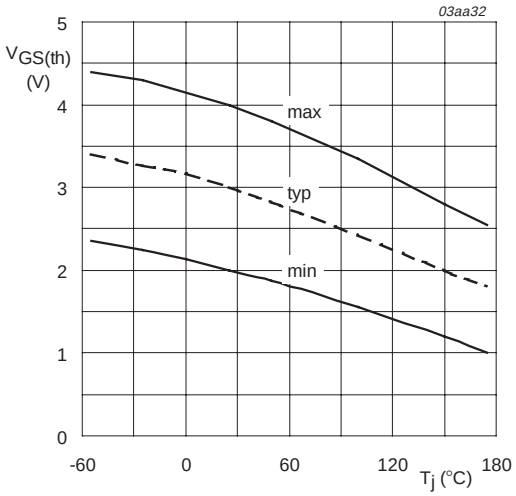
T_j = 25 °C; t_p = 300 µs

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



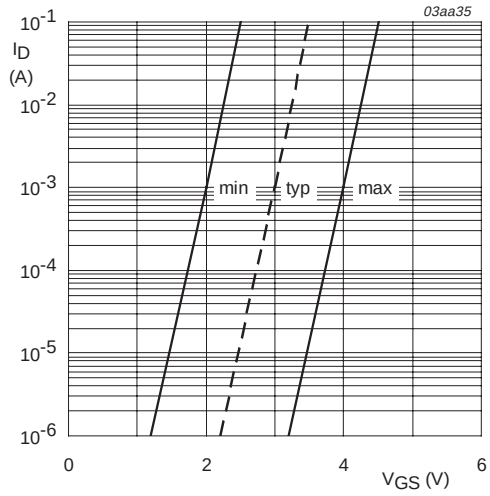
$$a = \frac{R_{DSon}}{R_{DSon(25^{\circ}C)}}$$

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



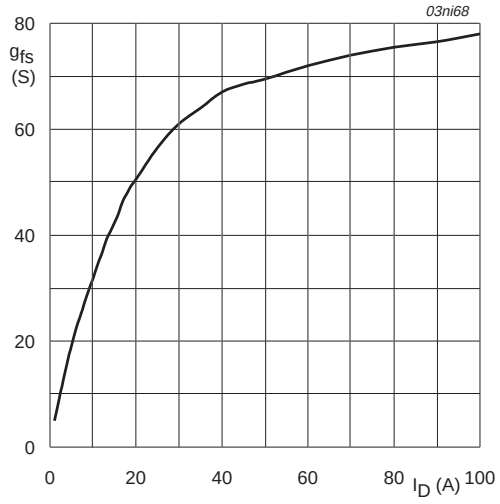
I_D = 1 mA; V_{DS} = V_{GS}

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



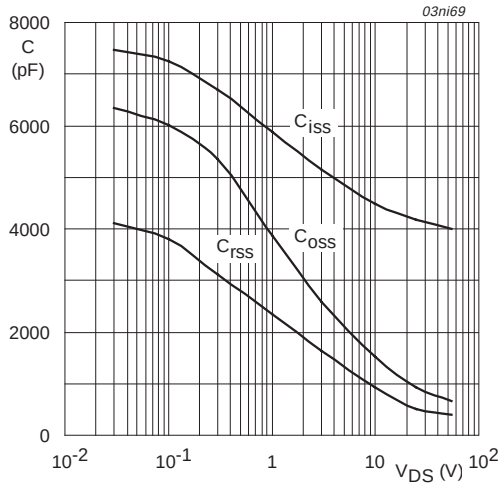
T_j = 25 °C; V_{DS} = V_{GS}

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



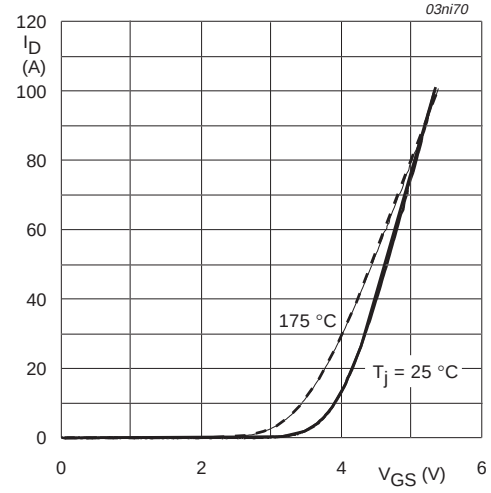
T_j = 25 °C; V_{DS} = 25 V

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



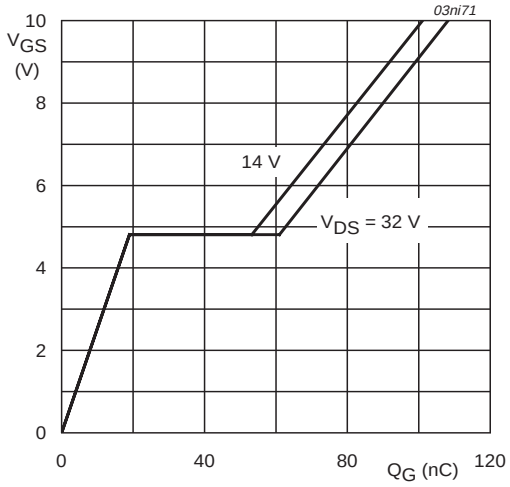
V_{GS} = 0 V; f = 1 MHz

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



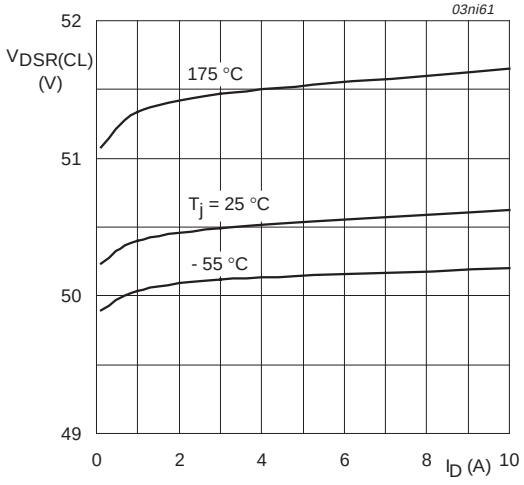
V_{DS} = 25 V

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



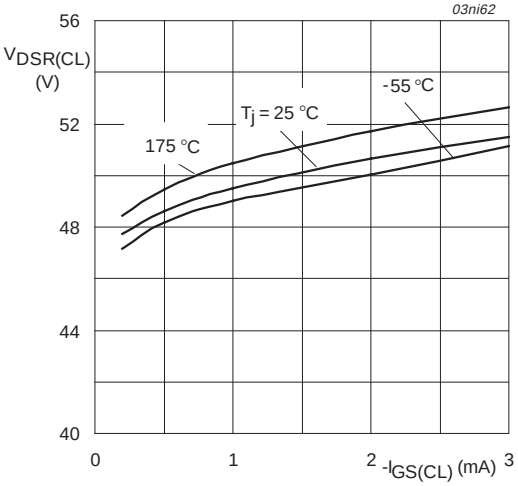
T_j = 25 °C; I_D = 25 A

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



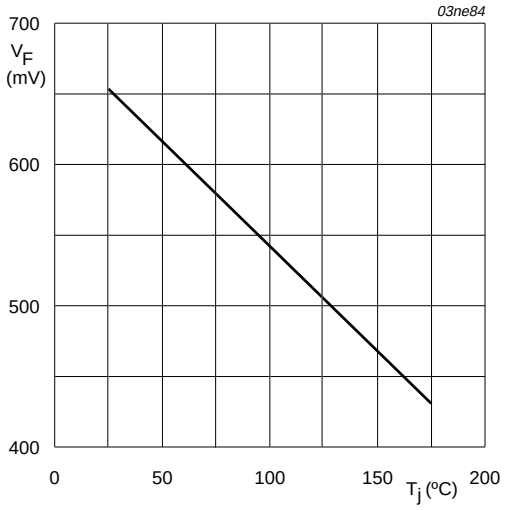
$I_{GS(CL)}$ = −2 mA

Fig 15. Drain-source clamping voltage as a function of drain current; typical values.



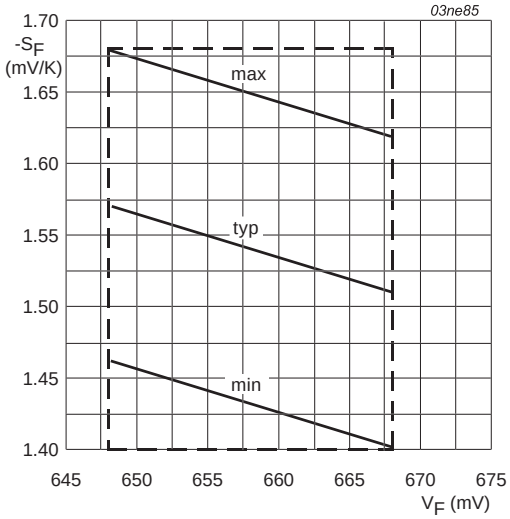
I_D = 10 A

Fig 16. Drain-source clamping voltage as a function of gate-source current; typical values.



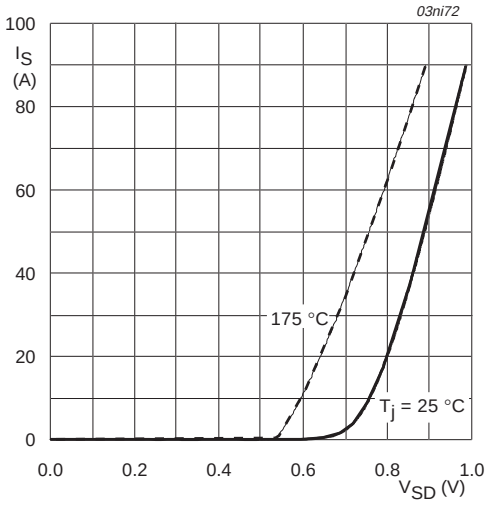
I_F = 250 µA

Fig 17. Forward voltage of temperature sense diode as a function of junction temperature; typical values.



V_F at T_j = 25 C; I_F = 250 µA

Fig 18. Temperature coefficient of temperature sense diode as a function of forward voltage; typical values.



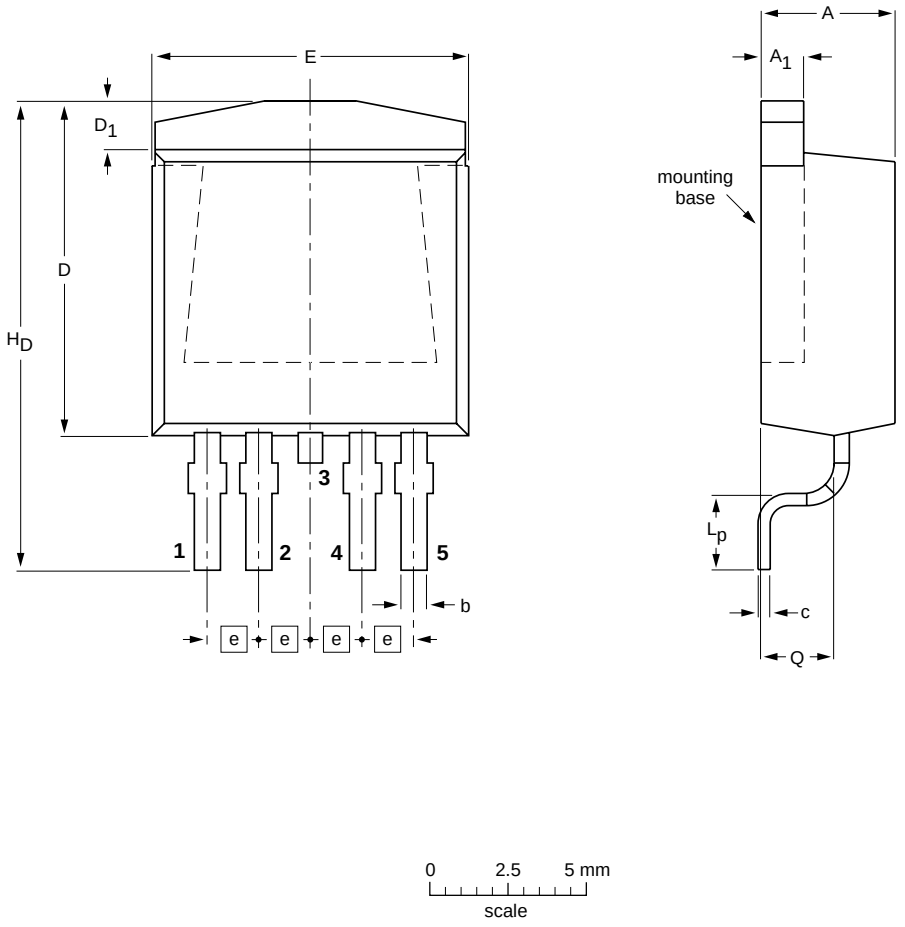
V_{GS} = 0 V

Fig 19. Reverse diode current as a function of reverse diode voltage; typical values.

6. Package outline

Plastic single-ended surface mounted package (Philips version of D^2-PAK); 5 leads (one lead cropped)

SOT426



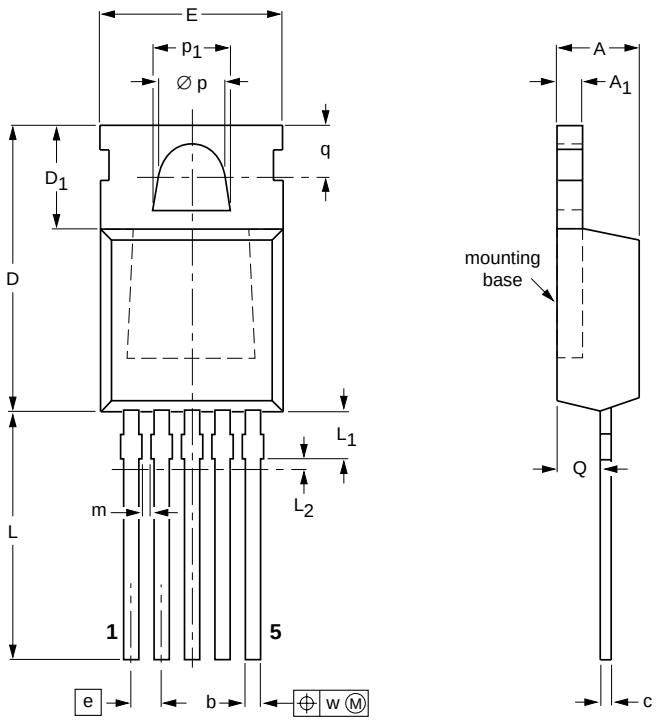
DIMENSIONS (mm are the original dimensions)

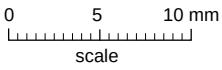
UNIT	A	A_1	b	c	D max.	D_1	E	e	L_p	H_D	Q
mm	4.50 4.10	1.40 1.27	0.85 0.60	0.64 0.46	11	1.60 1.20	10.30 9.70	1.70	2.90 2.10	15.80 14.80	2.60 2.20

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT426						~~98-12-14~~ 99-06-25

Fig 20. SOT426 (D^2-PAK).

Plastic single-ended package; heatsink mounted; 1 mounting hole; 5-lead TO-220 **SOT263B**





DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	c	D	D_1	E	e	L	L_1 (1)	L_2 (2)	m	∅ p	p_1	q	Q	w
mm	4.5 4.1	1.39 1.27	0.85 0.70	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	1.7	15.0 13.5	2.4 1.6	0.5	0.8 0.6	3.8 3.6	4.3 4.1	3.0 2.7	2.6 2.2	0.4

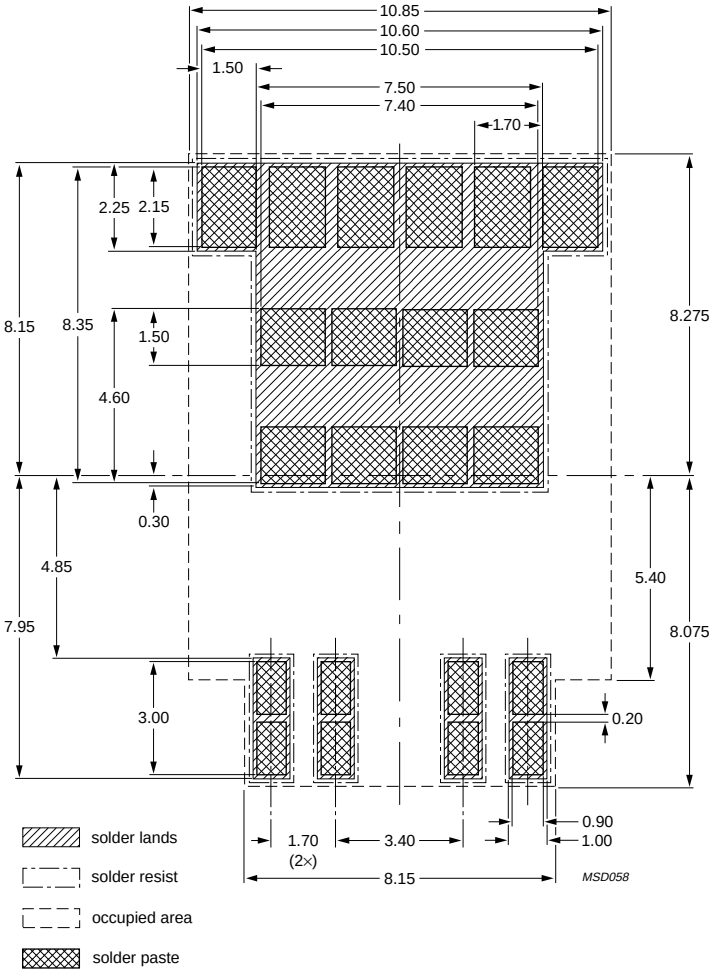
Notes

1. Terminal dimensions are uncontrolled in this zone.
2. Positional accuracy of the terminals is controlled in this zone.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT263B		5-lead TO-220				01-01-11

Fig 21. SOT263B (TO-220AB).

7. Soldering



Dimensions in mm.

Fig 22. Reflow soldering footprint for SOT426.

8. Revision history

Table 5: Revision history

Rev	Date	CPCN	Description
01	20020809	-	Product data; initial version

9. Data sheet status

Data sheet status[1]	Product status[2]	Definition
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.
Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A.

[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.

10. Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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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