

BUK71/794R1-40BT

TrenchMOS™ standard level FET

Rev. 01 — 4 November 2004

Product data

1. Product profile

1.1 Description

N-channel enhancement mode field-effect power transistor in a plastic package using Philips High-Performance Automotive (HPA) TrenchMOS™ technology. The devices include TrenchPLUS diodes for over-temperature protection.

Product availability:

BUK714R1-40BT in SOT426 (D²-PAK)

BUK794R1-40BT in SOT263B (TO-220AB).

1.2 Features

- Integrated temperature sensor
- Q101 compliant
- Very low on-state resistance
- 175 °C rated.

1.3 Applications

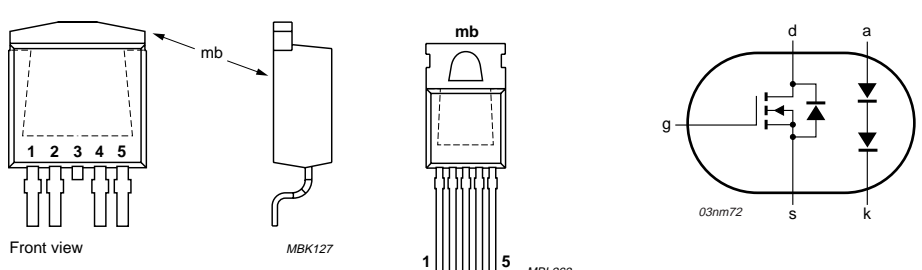
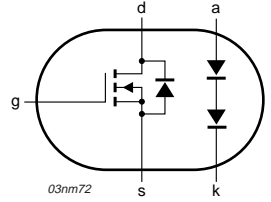
- Electrical Power Assisted Steering
- 12 V loads
- Motors, lamps and solenoids
- General purpose power switching.

1.4 Quick reference data

- $R_{DSon} = 3.4 \text{ m}\Omega$ (typ)
- $I_D \leq 75 \text{ A}$
- $V_{DS} \leq 40 \text{ V}$
- $P_{tot} \leq 272 \text{ W}$.

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)



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3. Limiting values

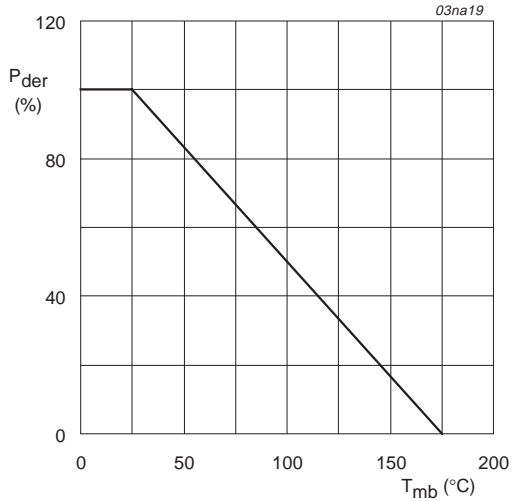
Table 2: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)		-	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] -	187	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	-	748	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] -	187	A
			[2] -	75	A
I_{DRM}	peak reverse drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$; pulsed; $t_p \leq 10 \text{ }\mu\text{s}$	-	748	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 $T_{mb} = 25 \text{ }^\circ\text{C}$	-	1.5	J
Electrostatic discharge					
V_{esd}	Electrostatic discharge voltage; pins 1,3,5	Human Body Model; $C = 100 \text{ pF}$; $R = 1.5 \text{ k}\Omega$	-	4	kV

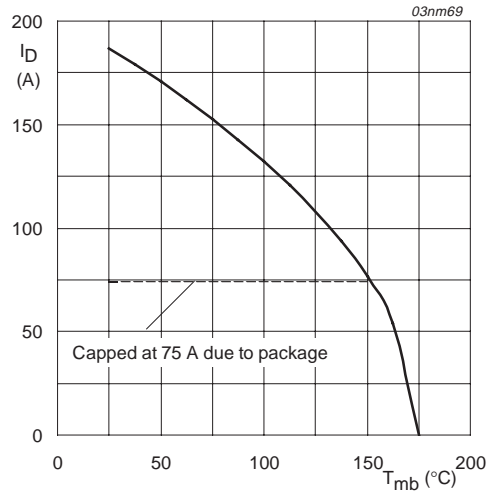
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.



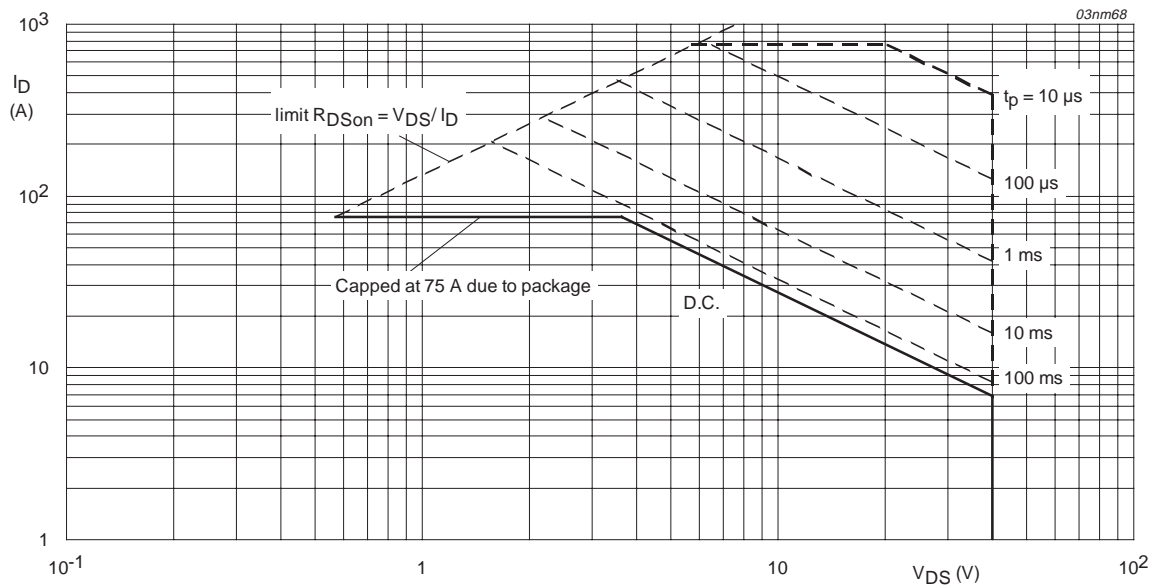
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



$V_{GS} \geq 10\text{ V}$

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



$T_{mb} = 25^{\circ}C$; 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
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	0.55	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient					
	SOT263B (TO-220AB)	vertical in still air	-	-	60	K/W
	SOT426 (D ² -PAK)	minimum footprint; mounted on a PCB	-	-	50	K/W

4.1 Transient thermal impedance

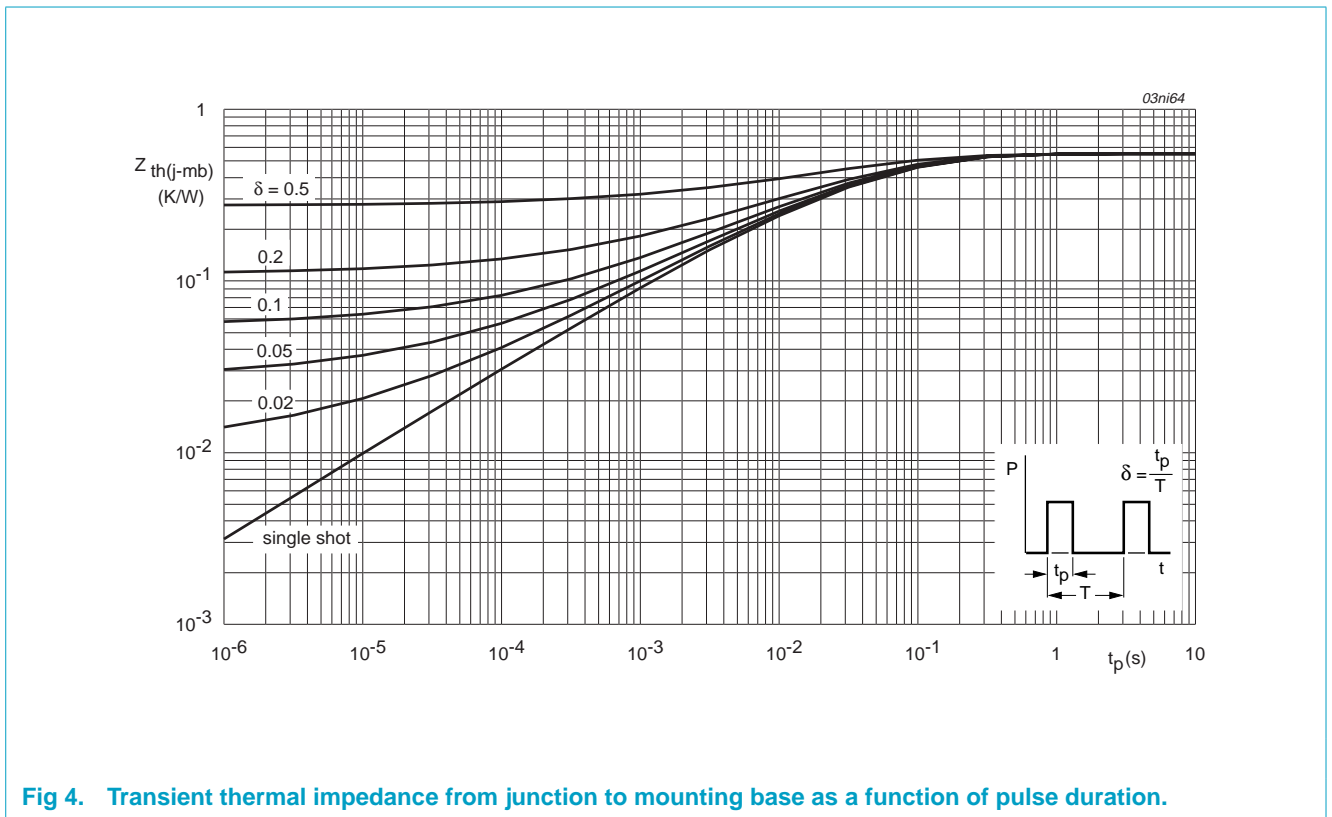


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

5. Characteristics

Table 4: Characteristics
T_j = 25 °C unless otherwise specified

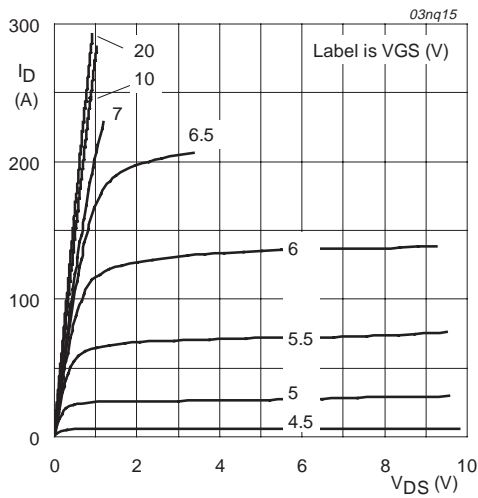
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
V _{(BR)DSS}	drain-source breakdown voltage	I _D = 0.25 mA; V _{GS} = 0 V				
		T _j = 25 °C	40	-	-	V
		T _j = -55 °C	36	-	-	V
V _{GS(th)}	gate-source threshold voltage	I _D = 1 mA; V _{DS} = V _{GS} ; Figure 9				
		T _j = 25 °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	-	0.02	1	μA
		T _j = 175 °C	-	-	500	μA
I _{GSS}	gate-source leakage current	V _{GS} = ±20 V; V _{DS} = 0 V	-	2	100	nA
R _{DS(on)}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 50 A; Figure 7 and 8				
		T _j = 25 °C	-	3.4	4.1	mΩ
		T _j = 175 °C	-	-	7.8	mΩ
V _F	temperature sense diode forward voltage	I _F = 1 mA	1.58	1.60	1.63	V
S _F	temperature sense diode temperature coefficient	I _F = 1 mA; -55 °C < T _j < 175 °C	-2.55	-2.83	-3.11	mV/K
Dynamic characteristics						
Q _{g(tot)}	total gate charge	V _{GS} = 10 V; V _{DD} = 32 V;	-	83	-	nC
Q _{gs}	gate-to-source charge	I _D = 25 A; Figure 14	-	18	-	nC
Q _{gd}	gate-to-drain (Miller) charge		-	29	-	nC
C _{iss}	input capacitance	V _{GS} = 0 V; V _{DS} = 25 V;	-	5106	6808	pF
C _{oss}	output capacitance	f = 1 MHz; Figure 12	-	1389	1667	pF
C _{rss}	reverse transfer capacitance		-	527	721	pF
t _{d(on)}	turn-on delay time	V _{DD} = 30 V; R _L = 1.2 Ω;	-	38	-	ns
t _r	rise time	V _{GS} = 10 V; R _G = 10 Ω	-	82	-	ns
t _{d(off)}	turn-off delay time		-	141	-	ns
t _f	fall time		-	90	-	ns
L _d	internal drain inductance	from drain lead 6 mm from package to center of die	-	4.5	-	nH
		from contact screw on mounting base to center of die SOT263B	-	3.5	-	nH
		from upper edge of drain mounting base to center of die SOT426	-	2.5	-	nH

Table 4: Characteristics...continued*T_j = 25 °C unless otherwise specified*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
L _s	internal source inductance	from source lead to source bond pad; lead length 6 mm	-	7.5	-	nH

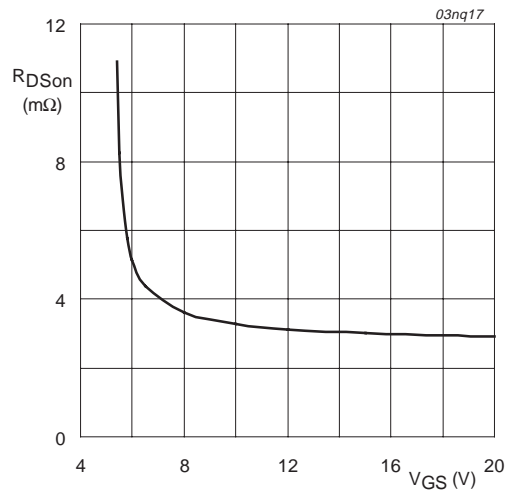
Source-drain diode

V _{SD}	source-drain (diode forward) voltage	I _S = 25 A; V _{GS} = 0 V; Figure 16	-	0.85	1.2	V
t _{rr}	reverse recovery time	I _S = 20 A; di _S /dt = -100 A/μs	-	70	-	ns
Q _r	recovered charge	V _{GS} = -10 V; V _{DS} = 30 V	-	55	-	nC



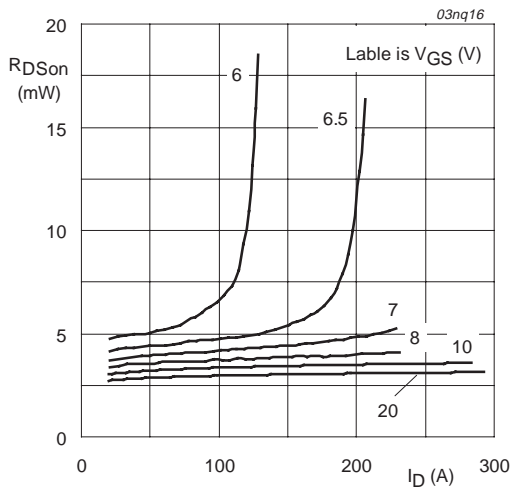
$T_j = 25^\circ\text{C}$; $t_p = 300 \mu\text{s}$

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



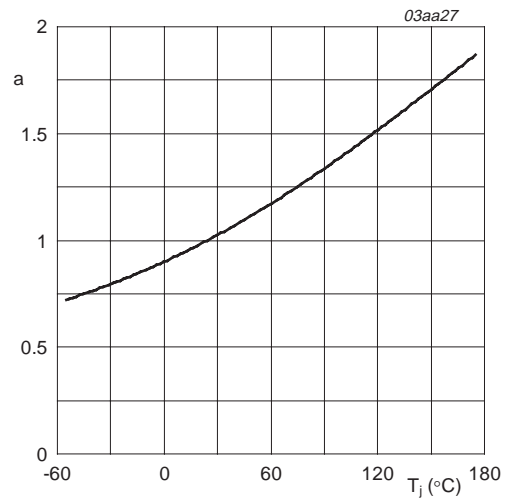
$T_j = 25^\circ\text{C}$; $I_D = 50 \text{ A}$

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



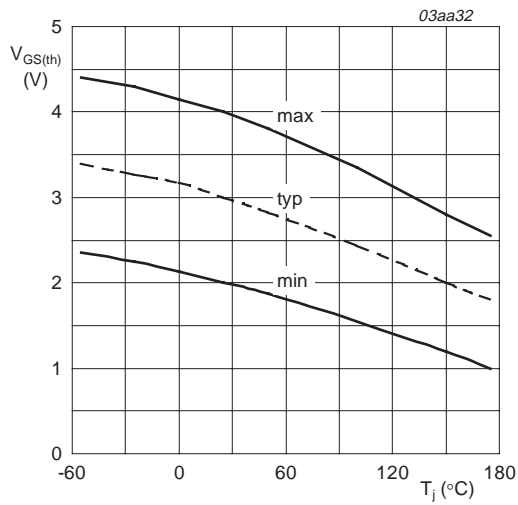
$T_j = 25^\circ\text{C}$

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



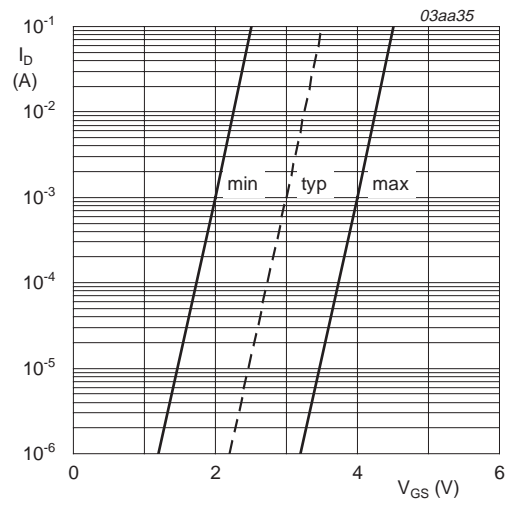
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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



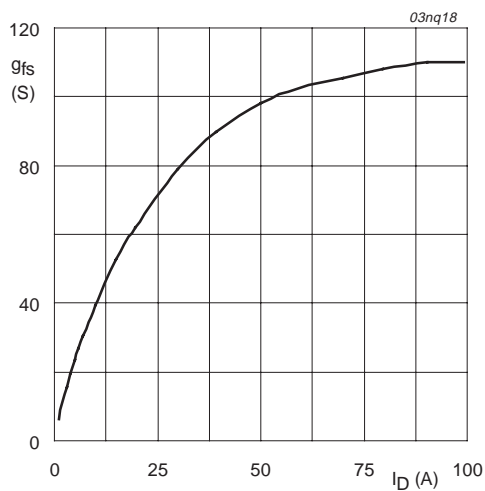
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



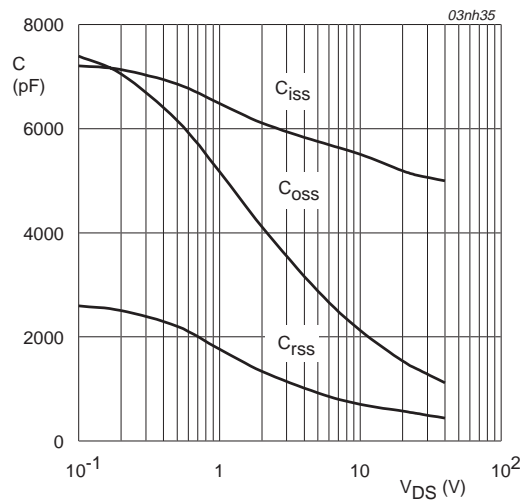
$T_j = 25 \text{ °C}; V_{DS} = V_{GS}$

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



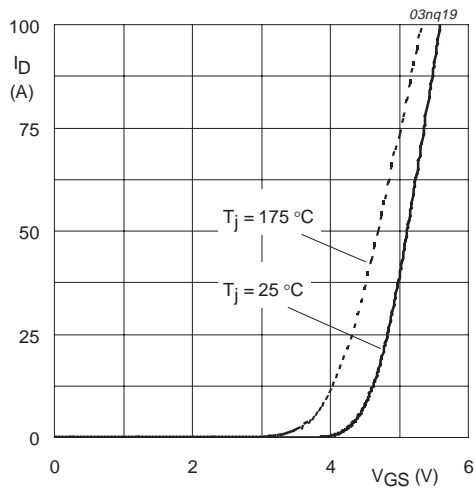
$T_j = 25 \text{ °C}; V_{DS} = 25 \text{ V}$

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



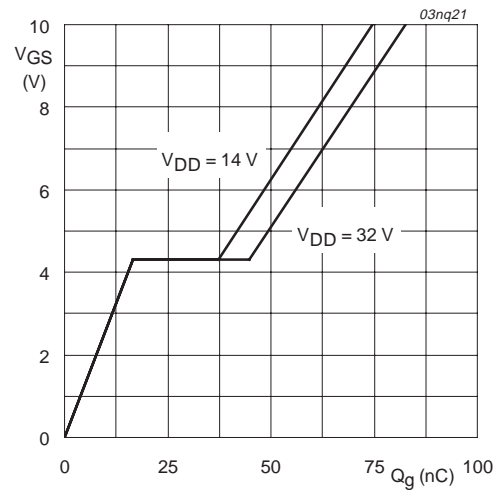
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



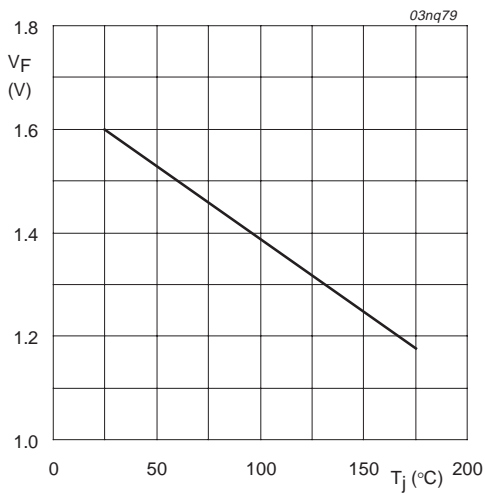
$V_{DS} = 25\text{ V}$

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



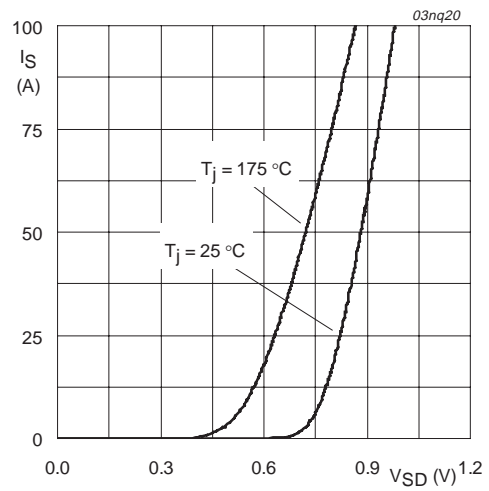
$T_j = 25\text{ }^\circ\text{C}; I_D = 25\text{ A}$

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



$I_F = 1\text{ mA}$

Fig 15. Forward voltage of temperature sense diode as a function of junction temperature; typical values.



$V_{GS} = 0\text{ V}$

Fig 16. Reverse diode current as a function of reverse diode voltage; typical values.

6. Package outline

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

SOT263B

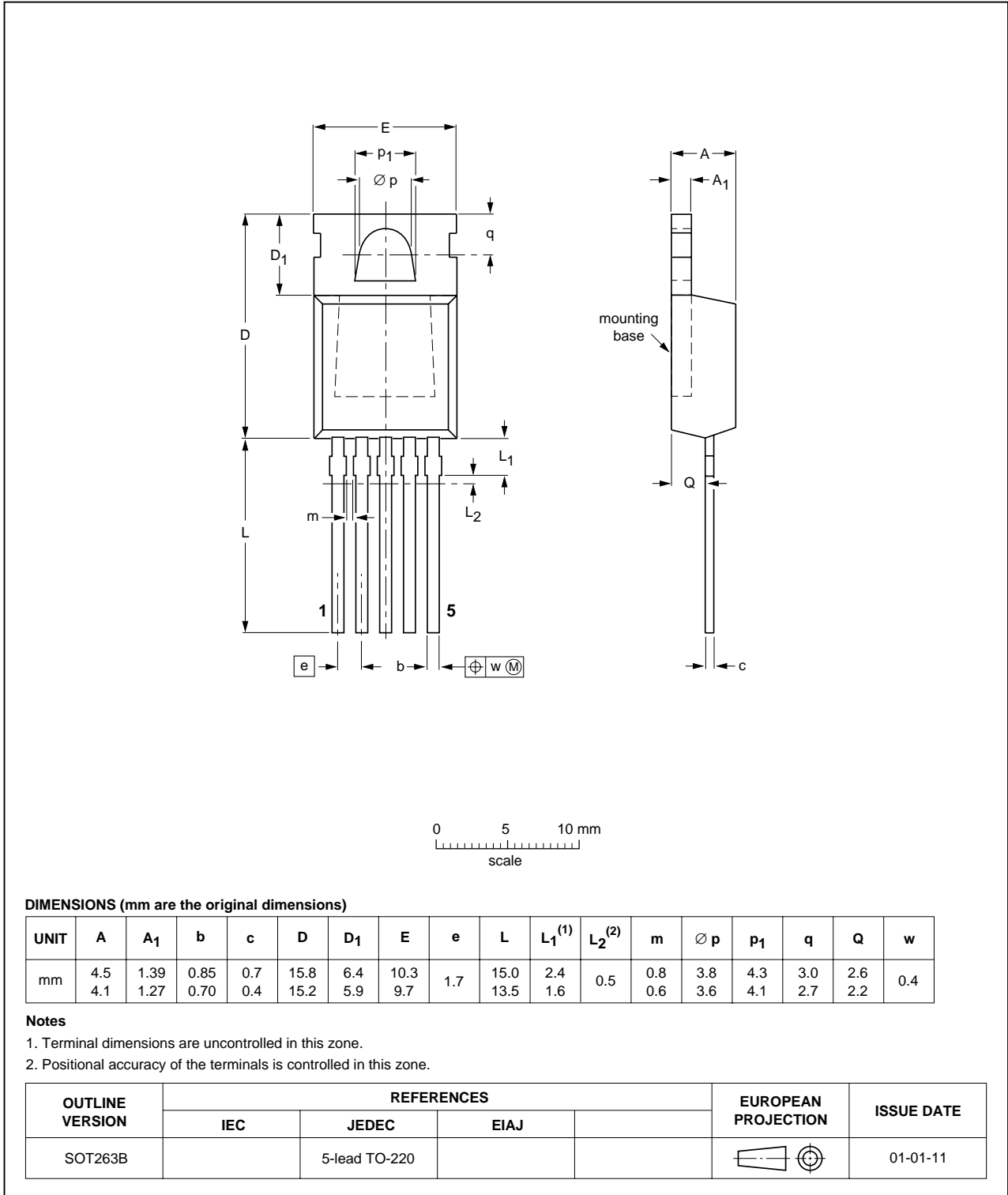


Fig 17. SOT263B (TO-220AB).

Plastic single-ended surface mounted package (D²-PAK); 5 leads (one lead cropped)

SOT426

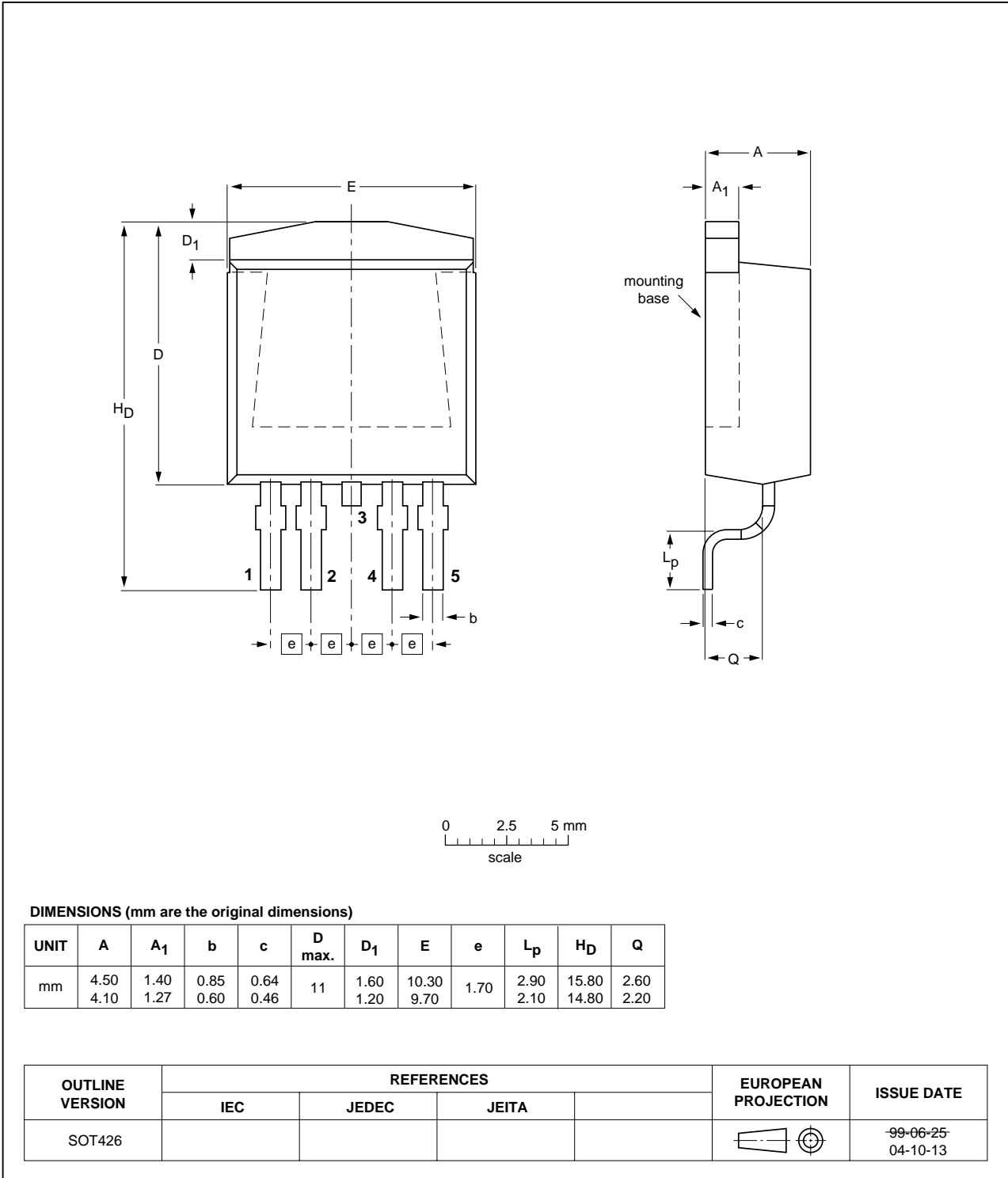
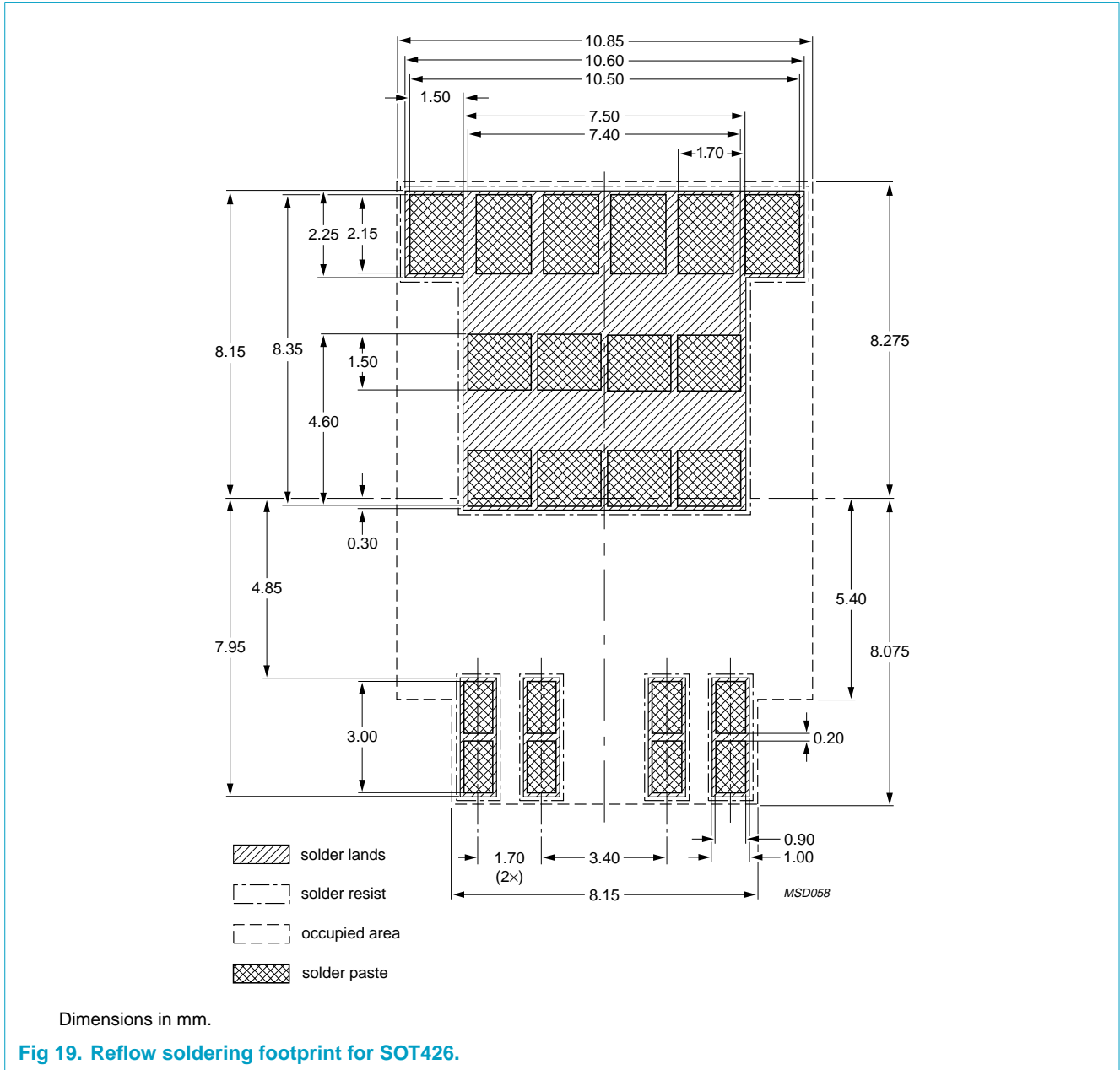


Fig 18. SOT426 (D²-PAK)

7. Soldering



8. Revision history

Table 5: Revision history

Rev	Date	CPCN	Description
01	20041104	-	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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