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Kind regards,

Team Nexperia

BUK9107-40ATC

N-channel TrenchPLUS logic level FET

Rev. 04 — 16 February 2009 **Product data sheet**

1. Product profile

1.1 General description

Logic level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. The devices include TrenchPLUS diodes for clamping, ElectroStatic Discharge (ESD) protection and temperature sensing. This product has been designed and qualified to the appropriate AEC standard for use in automotive critical applications.

1.2 Features and benefits

- Allows responsive temperature monitoring due to integrated temperature sensor
- Low conduction losses due to low on-state resistance
- Q101 compliant

1.3 Applications

- 12 V and 24 V high power motor drives
- Automotive and general purpose power switching
- Electrical Power Assisted Steering (EPAS)
- Protected drive for lamps

1.4 Quick reference data

Table 1. Quick reference

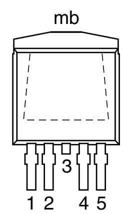
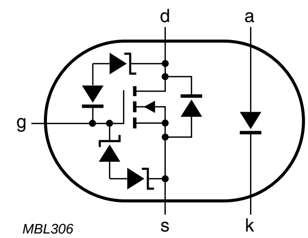
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_D	drain current	V_{GS} = 5 V; T_{mb} = 25 °C; see Figure 2; see Figure 3	[1]	-	-	140	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; see Figure 1		-	-	272	W
T_j	junction temperature			-55	-	175	°C
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 50 A; T_j = 25 °C		-	5.2	6.2	mΩ
		V_{GS} = 4.5 V; I_D = 50 A; T_j = 25 °C		-	6	7.7	mΩ
		V_{GS} = 5 V; I_D = 50 A; T_j = 25 °C; see Figure 7; see Figure 8		-	5.8	7	mΩ
$S_{F(TSD)}$	temperature sense diode temperature coefficient	I_F = 250 µA; T_j > -55 °C; T_j < 175 °C		-1.4	-1.54	-1.68	mV/K
$V_{F(TSD)}$	temperature sense diode forward voltage	I_F = 250 µA; T_j = 25 °C		648	658	668	mV

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

founded by Philips

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 **SOT426 (D2PAK)**	
2	A	anode		
3	D	drain		
4	K	cathode		
5	S	source		
mb	D	mounting base; connected to drain		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK9107-40ATC	D2PAK	plastic single-ended surface-mounted package (D2PAK); 5 leads (one lead cropped)	SOT426

4. Limiting values

Table 4. Limiting values

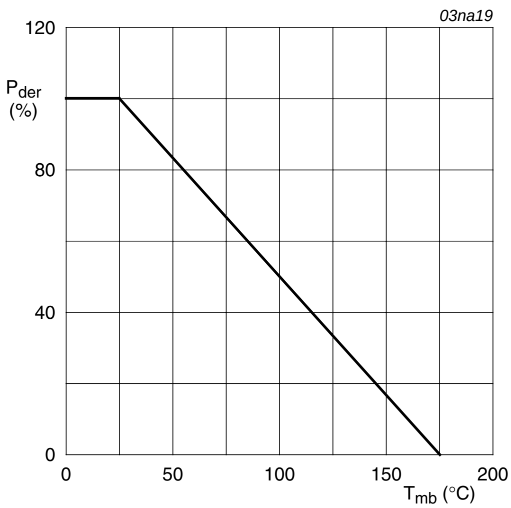
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C;	[1]	-	40	V
V_{GS}	gate-source voltage		[1]	-15	15	V
I_D	drain current	$T_{mb} = 25$ °C; $V_{GS} = 5$ V; see Figure 2; see Figure 3	[2]	-	140	A
		$T_{mb} = 25$ °C; $V_{GS} = 5$ V; see Figure 2; see Figure 3	[3]	-	75	A
		$T_{mb} = 100$ °C; $V_{GS} = 5$ V; see Figure 2	[3]	-	75	A
I_{DM}	peak drain current	$T_{mb} = 25$ °C; $t_p \leq 10$ µs; pulsed; see Figure 3		-	560	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; see Figure 1		-	272	W
$I_{DG(CL)}$	drain-gate clamping current	pulsed; $t_p = 5$ ms; $\delta = 0.01$		-	50	mA
$I_{GS(CL)}$	gate-source clamping current	pulsed; $t_p = 5$ ms; $\delta = 0.01$		-	50	mA
		continuous		-	10	mA
$V_{isol(FET-TSD)}$	FET to temperature sense diode isolation voltage			-100	100	V
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
V_{DGS}	drain-gate voltage	$I_{DG} = 250$ µA;	[1]	-	40	V
Source-drain diode						
I_S	source current	$T_{mb} = 25$ °C;	[2]	-	140	A
		$T_{mb} = 25$ °C;	[3]	-	75	A
I_{SM}	peak source current	$t_p \leq 10$ µs; pulsed; $T_{mb} = 25$ °C		-	560	A
Clamping						
$E_{DS(CL)S}$	non-repetitive drain-source clamping energy	$I_D = 75$ A; $V_{DS} \leq 40$ V; $V_{GS} = 5$ V; $R_{GS} = 10$ kΩ; unclamped; $T_{j(init)} = 25$ °C		-	1.4	J
Electrostatic discharge						
V_{esd}	electrostatic discharge voltage	HBM; C = 100 pF; R = 1.5 kΩ; pins 1, 3, 5		-	6	kV

[1] Voltage is limited by clamping.

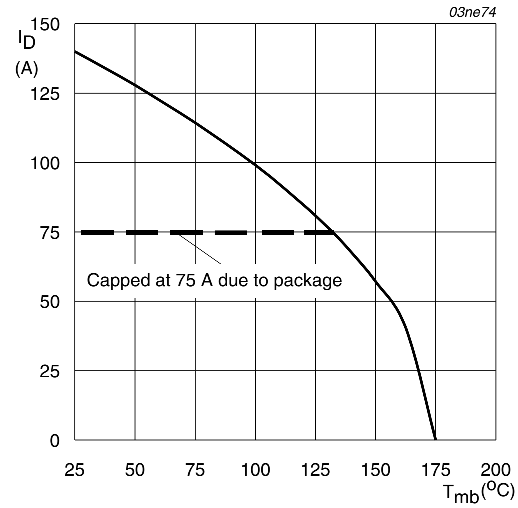
[2] Current is limited by power dissipation chip rating.

[3] Continuous current is limited by package.



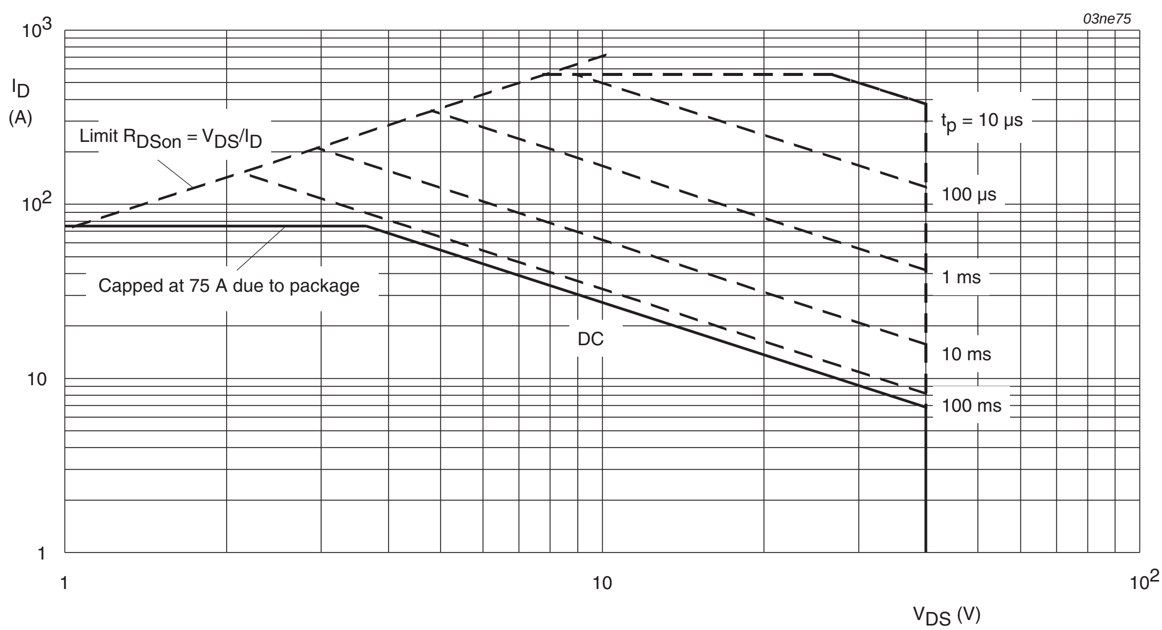
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



$$V_{GS} \geq 5V$$

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



$$T_{mb} = 25°C; I_{DM} \text{is single pulse}$$

Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	mounted on printed-circuit board; minimum footprint	-	-	50	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see Figure 4	-	-	0.55	K/W

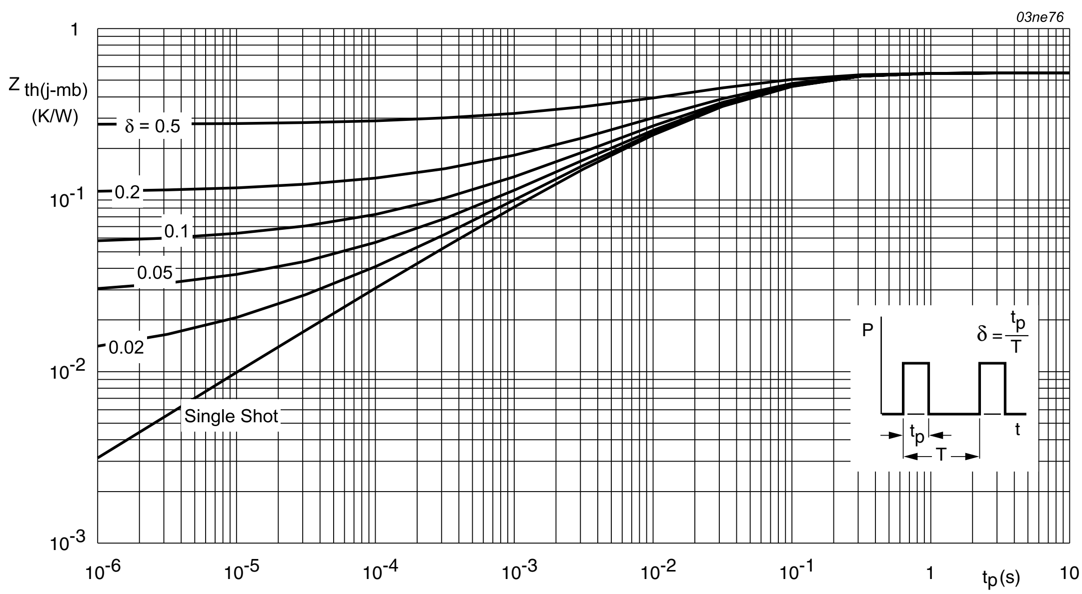


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

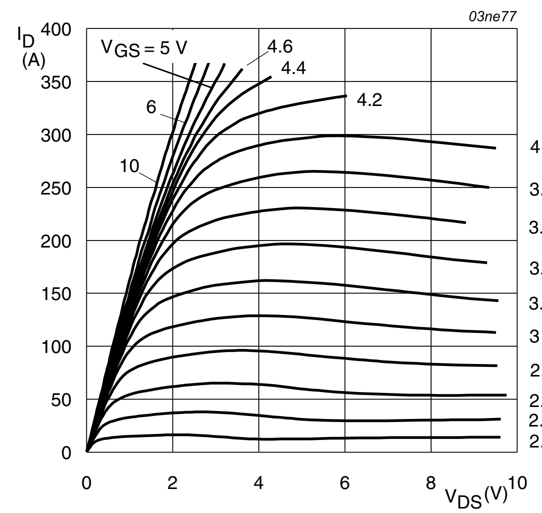
6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DG}$	drain-gate (Zener diode) breakdown voltage	I_D = 0.25 mA; V_{GS} = 0 V; T_j = 25 °C	40	-	-	V
		I_D = 0.25 mA; V_{GS} = 0 V; T_j = -55 °C	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C; see Figure 9	1	1.5	2	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; see Figure 9	0.5	-	-	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; see Figure 9	-	-	2.3	V
I_{DSS}	drain leakage current	V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 °C	-	0.1	100	µA
		V_{DS} = 40 V; V_{GS} = 0 V; T_j = 175 °C	-	-	250	µA
$V_{(BR)GSS}$	gate-source breakdown voltage	I_G = 1 mA; V_{DS} = 0 V; T_j > -55 °C; T_j < 175 °C	12	15	-	V
		I_G = -1 mA; V_{DS} = 0 V; T_j > -55 °C; T_j < 175 °C	12	15	-	V
I_{GSS}	gate leakage current	V_{DS} = 0 V; V_{GS} = 5 V; T_j = 25 °C	-	5	1000	nA
		V_{DS} = 0 V; V_{GS} = -5 V; T_j = 25 °C	-	5	1000	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 5 V; I_D = 50 A; T_j = 25 °C; see Figure 7; see Figure 8	-	5.8	7	mΩ
		V_{GS} = 5 V; I_D = 50 A; T_j = 175 °C; see Figure 7; see Figure 8	-	-	14	mΩ
		V_{GS} = 4.5 V; I_D = 50 A; T_j = 25 °C	-	6	7.7	mΩ
		V_{GS} = 10 V; I_D = 50 A; T_j = 25 °C	-	5.2	6.2	mΩ
$V_{F(TSD)}$	temperature sense diode forward voltage	I_F = 250 µA; T_j = 25 °C	648	658	668	mV
$S_{F(TSD)}$	temperature sense diode temperature coefficient	I_F = 250 µA; T_j > -55 °C; T_j < 175 °C	-1.4	-1.54	-1.68	mV/K
$V_{F(TSD)hys}$	temperature sense diode forward voltage hysteresis	I_F > 125 µA; I_F < 250 µA; T_j = 25 °C	25	32	50	mV
Dynamic characteristics						
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; T_j = 25 °C; see Figure 12	-	5836	-	pF
C_{oss}	output capacitance		-	958	-	pF
C_{rss}	reverse transfer capacitance		-	595	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 1.2 Ω; V_{GS} = 5 V; $R_{G(ext)}$ = 1 kΩ; T_j = 25 °C	-	3	-	µs
t_r	rise time		-	10	-	µs
$t_{d(off)}$	turn-off delay time		-	17	-	µs
t_f	fall time		-	11	-	µs

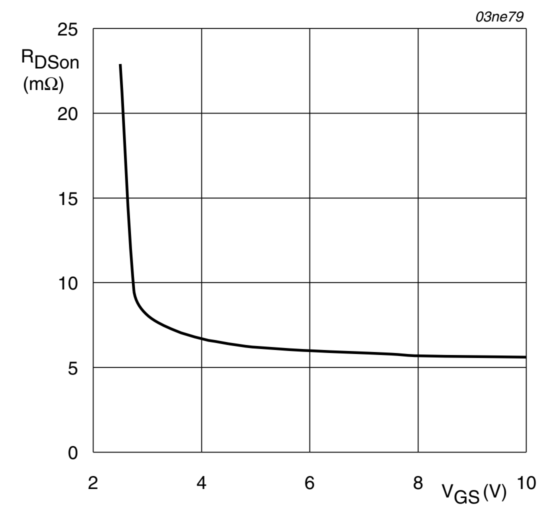
Table 6. Characteristics *…continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
L_D	internal drain inductance	measured from upper edge of drain mounting base to centre of die; T_j = 25 °C	-	2.5	-	nH
L_S	internal source inductance	measured from source lead to source bond pad; T_j = 25 °C	-	7.5	-	nH
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; see 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; T_j = 25 °C	-	85	-	ns
Q_r	recovered charge		-	250	-	nC



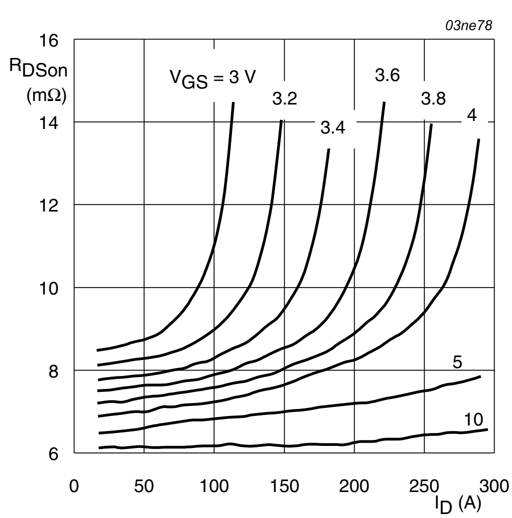
$$T_j = 25°C; t_p = 300 \mu s$$

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



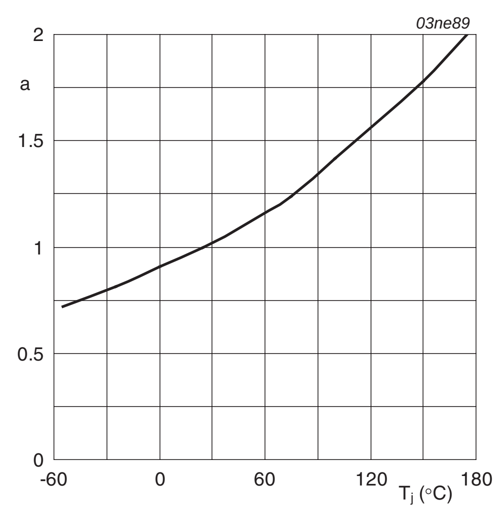
$$T_j = 25°C; I_D = 50A$$

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



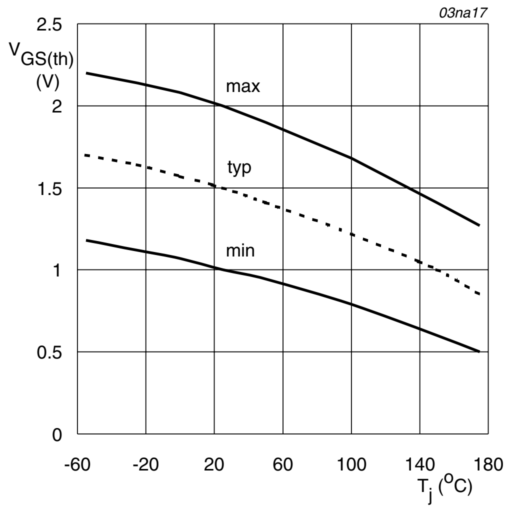
$$T_j = 25°C; t_p = 300 \mu s$$

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



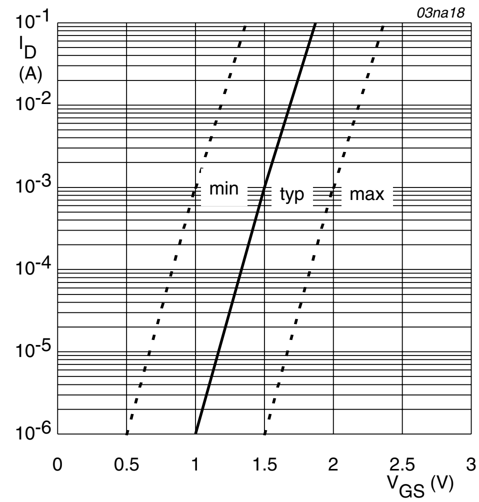
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



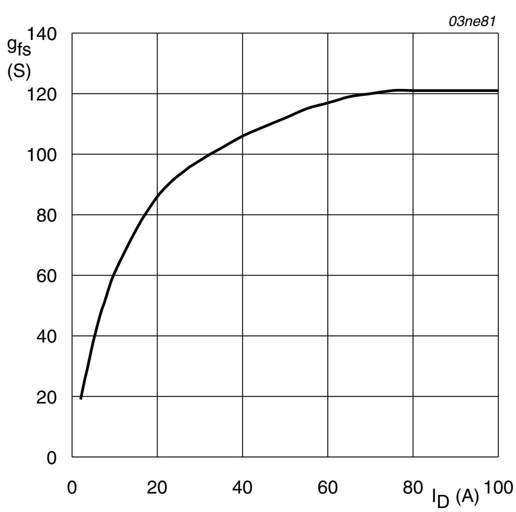
$I_D = 1mA; V_{DS} = V_{GS}$

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



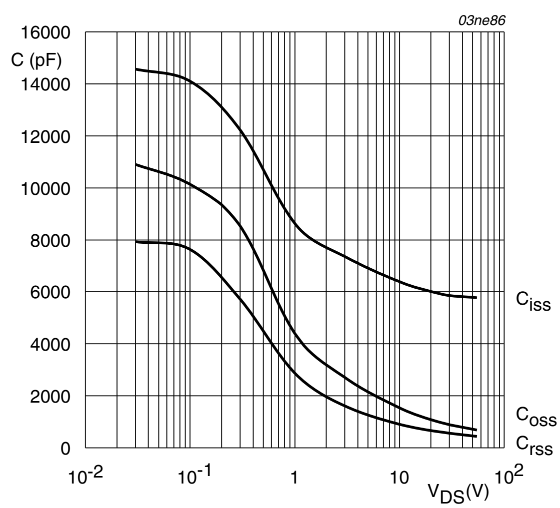
$T_j = 25°C; V_{DS} = V_{GS}$

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



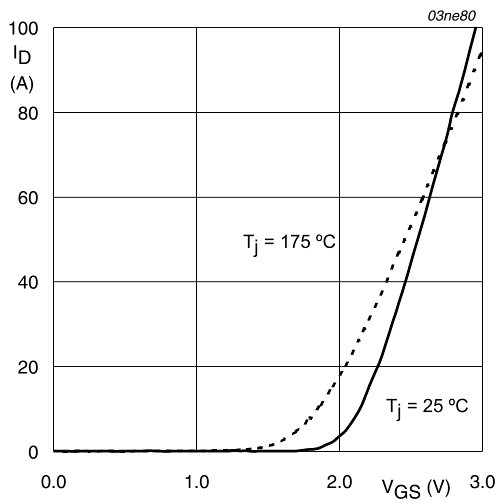
$T_j = 25°C; V_{DS} = 25V$

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



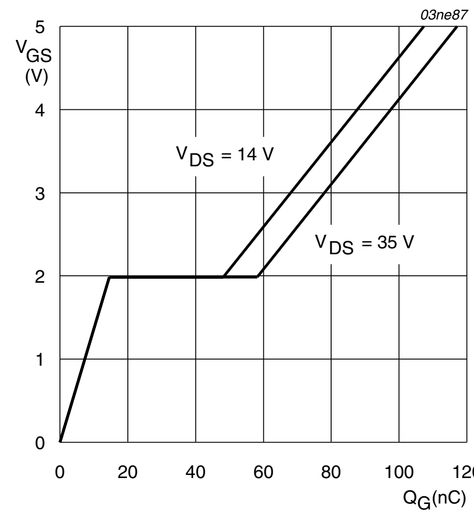
$V_{GS} = 0V; f = 1MHz$

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



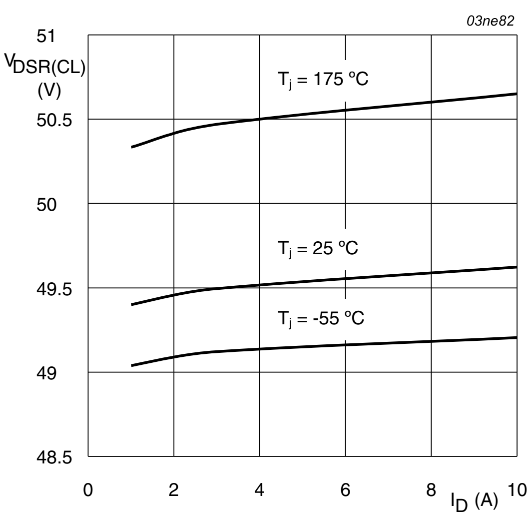
$$V_{DS} = 25V$$

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



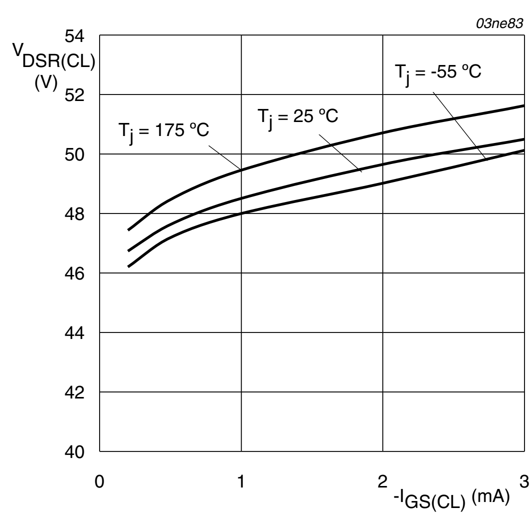
$$T_j = 25°C; I_D = 50A$$

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



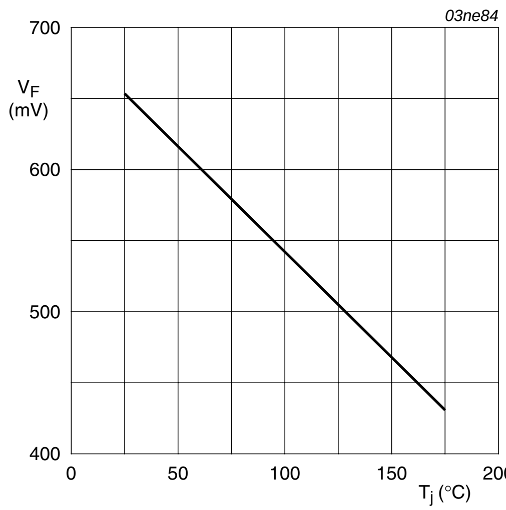
$$I_G = -2mA$$

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



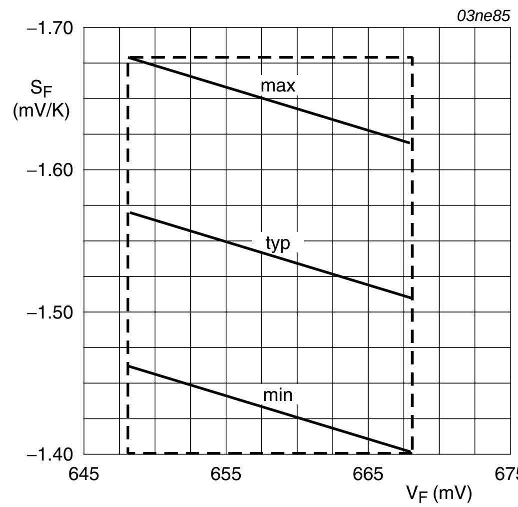
$$I_D = 10A$$

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



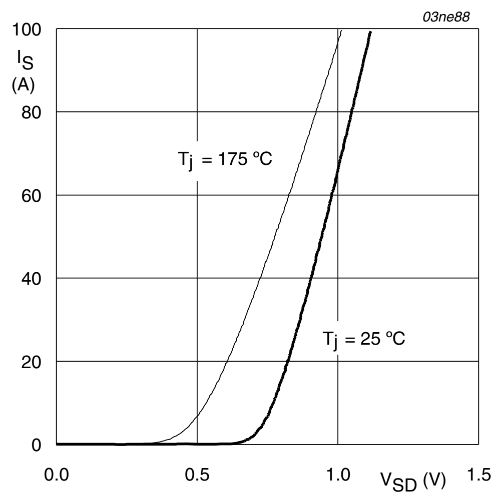
$I_F = 250\mu A$

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



V_F at $T_j = 25°C; I_F = 250\mu A$

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

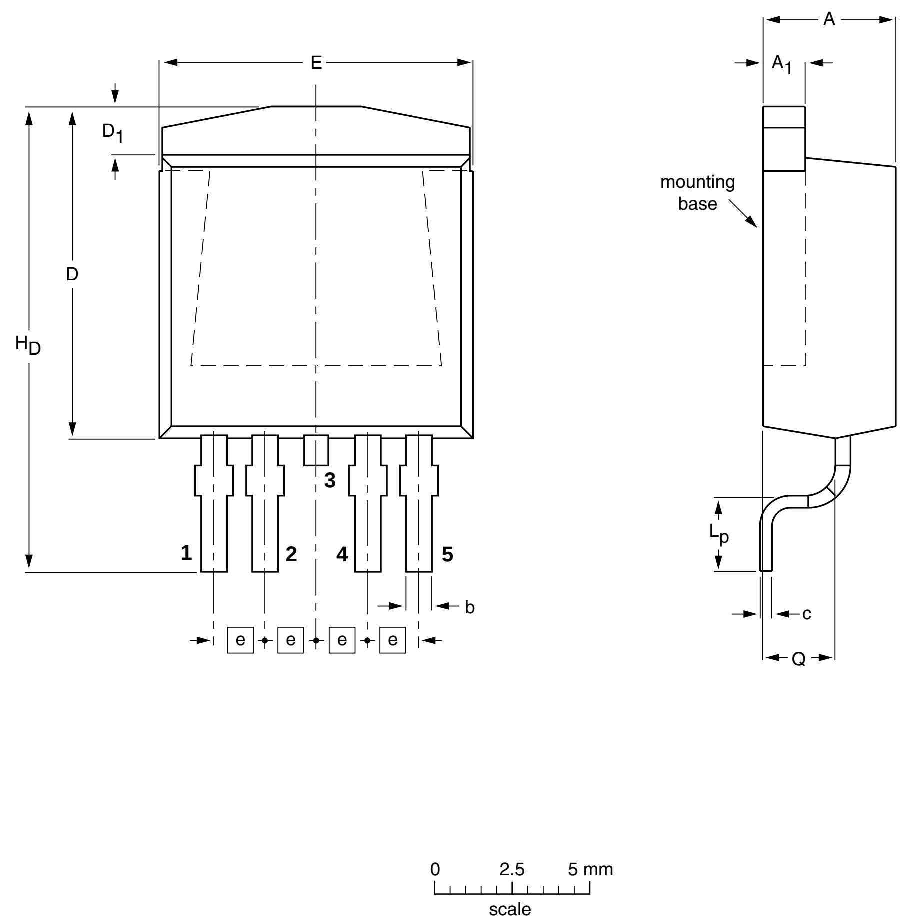


$V_{GS} = 0V$

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

7. Package outline

Plastic single-ended surface-mounted package (D2PAK); 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

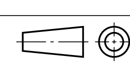
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT426						~~05-03-09~~ 06-03-16

Fig 20. Package outline SOT426 (D2PAK)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK9107-40ATC_4	20090216	Product data sheet	-	BUK9107_40ATC-03
Modifications:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate.			
BUK9107_40ATC-03 (9397 750 08724)	20020122	Product data sheet	-	BUK9107_40ATC-02
BUK9107_40ATC-02 (9397 750 08709)	20010829	Product data sheet	-	BUK9107_40ATC-01
BUK9107_40ATC-01 (9397 750 08319)	20010814	Product data sheet	-	-

9. Legal information

9.1 Data sheet status

Document status [1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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11. Contents

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Document identifier: BUK9107-40ATC_4