BUK7905-40ATE

N-channel TrenchPLUS standard level FET

Rev. 02 — 10 February 2009 **Product data sheet**

1. Product profile

1.1 General description

Standard level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. The devices include TrenchPLUS diodes for temperature sensing and ElectroStatic Discharge (ESD) protection. 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
- Electrostatically robust due to integrated protection diodes
- Low conduction losses due to low on-state resistance
- Q101 compliant
- Suitable for standard level gate drive sources

1.3 Applications

- Electrical Power Assisted Steering (EPAS)
- Variable Valve Timing for engines

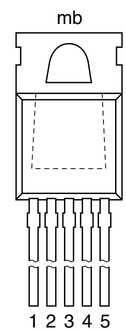
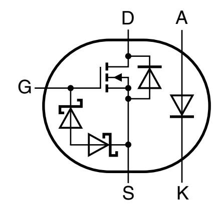
1.4 Quick reference data

Table 1. Quick reference

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C	-	-	40	V
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 50$ A; $T_j = 25$ °C; see Figure 7; see Figure 8	-	4.5	5	mΩ
$S_{F(TSD)}$	temperature sense diode temperature coefficient	$I_F = 250$ µA; $T_j \geq -55$ °C; $T_j \leq 175$ °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
$V_{F(TSD)hys}$	temperature sense diode forward voltage hysteresis	$I_F \leq 250$ µA; $T_j = 25$ °C; $I_F \geq 125$ µA	25	32	50	mV

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 **SOT263B (TO-220)**	
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
BUK7905-40ATE	TO-220	plastic single-ended package; heatsink mounted; 1 mounting hole; 5-lead TO-220	SOT263B

4. Limiting values

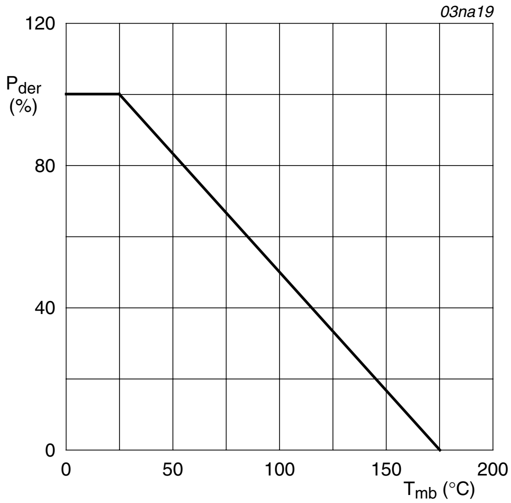
Table 4. Limiting values

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		-	40	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	$T_{mb} = 25$ °C; $V_{GS} = 10$ V; see Figure 2; see Figure 3	[1]	-	155	A
			[2]	-	75	A
		$T_{mb} = 100$ °C; $V_{GS} = 10$ V; see Figure 2	[2]	-	75	A
I_{DM}	peak drain current	$T_{mb} = 25$ °C; $t_p \leq 10$ µs; pulsed; see Figure 3		-	620	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; see Figure 1		-	272	W
$I_{GS(CL)}$	gate-source clamping current	continuous		-	10	mA
		pulsed; $t_p = 5$ ms; $\delta = 0.01$		-	50	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
Source-drain diode						
I_S	source current	$T_{mb} = 25$ °C	[1]	-	155	A
			[2]	-	75	A
I_{SM}	peak source current	$t_p \leq 10$ µs; pulsed; $T_{mb} = 25$ °C		-	620	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75$ A; $V_{sup} \leq 40$ V; $R_{GS} = 50$ Ω; $V_{GS} = 10$ V; $T_{j(init)} = 25$ °C; unclamped		-	1.46	J
Electrostatic discharge						
V_{esd}	electrostatic discharge voltage	HBM; C = 100 pF; R = 1.5 kΩ		-	6	kV

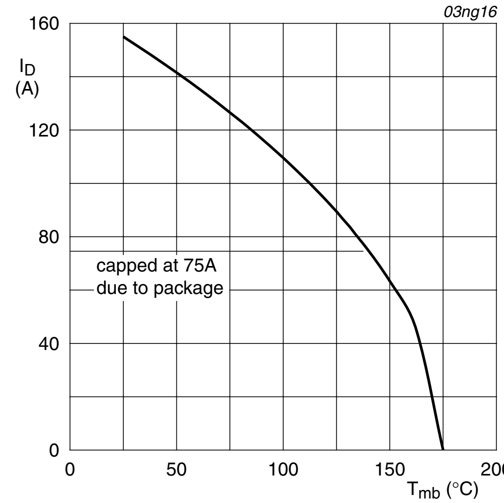
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.



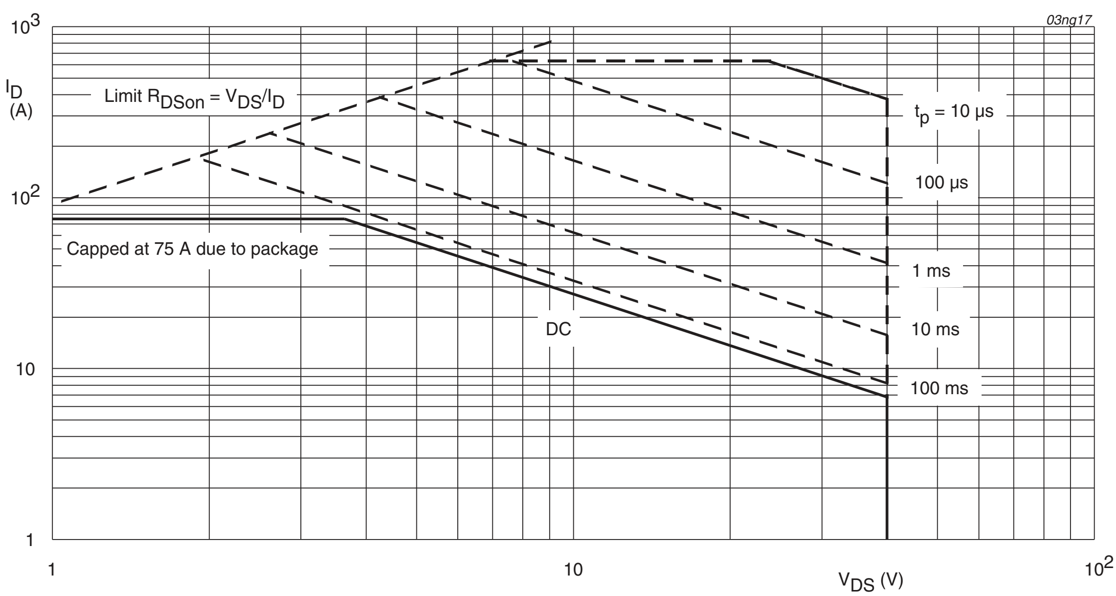
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



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

Fig 2. 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	vertical in still air	-	60	-	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see Figure 4	-	-	0.55	K/W

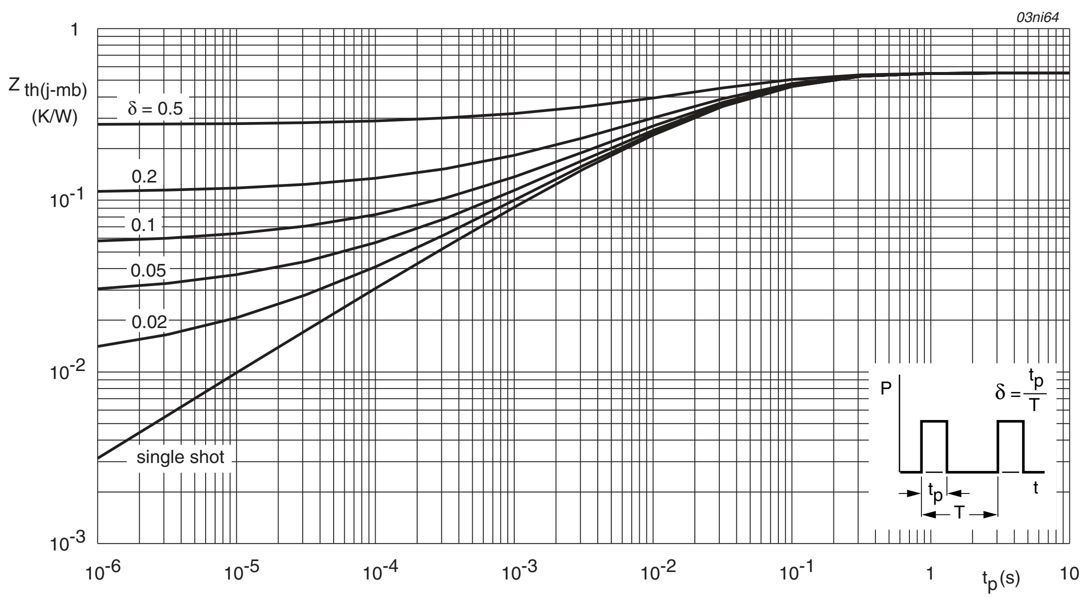


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

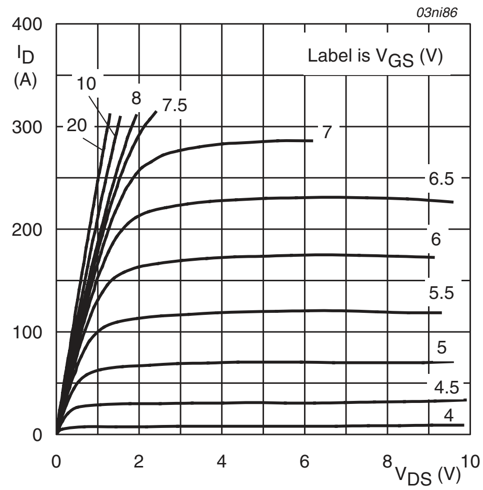
6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source 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	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C; see Figure 9	2	3	4	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; see Figure 9	1	-	-	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; see Figure 9	-	-	4.4	V
I_{DSS}	drain leakage current	V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 °C	-	0.1	10	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 ≤ 175 °C; T_j ≥ -55 °C	20	22	-	V
		I_G = -1 mA; V_{DS} = 0 V; T_j ≤ 175 °C; T_j ≥ -55 °C	20	22	-	V
I_{GSS}	gate leakage current	V_{DS} = 0 V; V_{GS} = 10 V; T_j = 25 °C	-	22	1000	nA
		V_{DS} = 0 V; V_{GS} = -10 V; T_j = 25 °C	-	22	1000	nA
		V_{DS} = 0 V; V_{GS} = 10 V; T_j = 175 °C	-	-	10	µA
		V_{DS} = 0 V; V_{GS} = -10 V; T_j = 175 °C	-	-	10	µA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 50 A; T_j = 25 °C; see Figure 7; see Figure 8	-	4.5	5	mΩ
		V_{GS} = 10 V; I_D = 50 A; T_j = 175 °C; see Figure 7; see Figure 8	-	-	9.5	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 ≤ 250 µA; I_F ≥ 125 µA; T_j = 25 °C	25	32	50	mV
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 32 V; V_{GS} = 10 V; T_j = 25 °C; see Figure 14	-	118	-	nC
Q_{GS}	gate-source charge		-	16	-	nC
Q_{GD}	gate-drain charge		-	57	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; T_j = 25 °C; see Figure 12	-	4500	-	pF
C_{oss}	output capacitance		-	1500	-	pF
C_{rss}	reverse transfer capacitance		-	960	-	pF

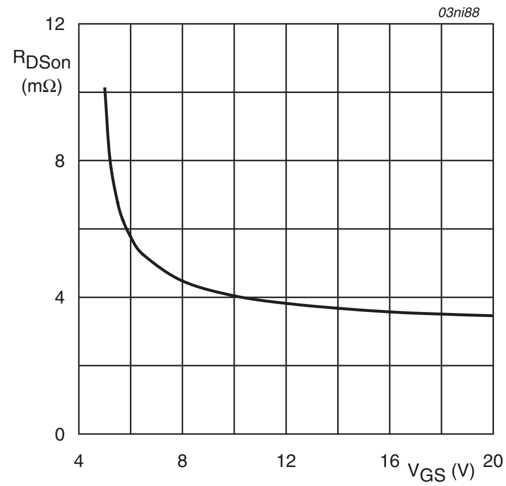
Table 6. Characteristics *…continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 1.2 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 10 Ω; T_j = 25 °C	-	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	from upper edge of mounting base to centre of die; T_j = 25 °C	-	2.5	-	nH
L_S	internal source inductance	from source lead to source bond pad; T_j = 25 °C	-	7.5	-	nH
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 40 A; V_{GS} = 0 V; T_j = 25 °C; see Figure 17	-	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	-	96	-	ns
Q_r	recovered charge		-	224	-	nC



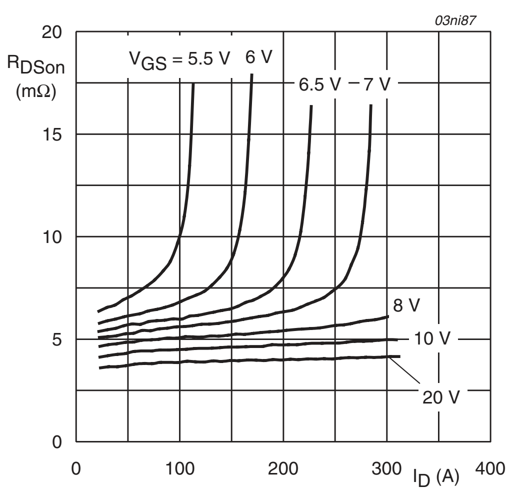
$T_j = 25°C; t_p = 300 \mu s$

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



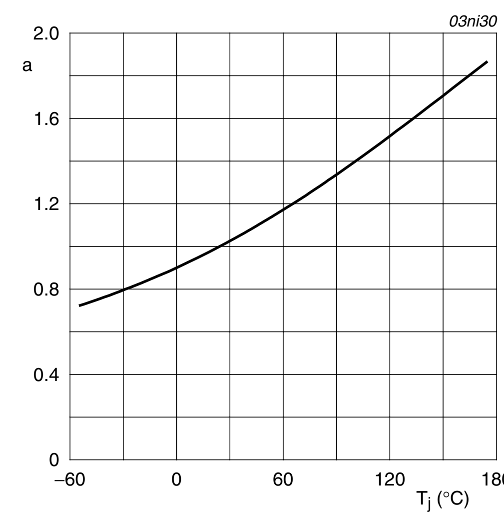
$T_j = 25°C; I_D = 50A$

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



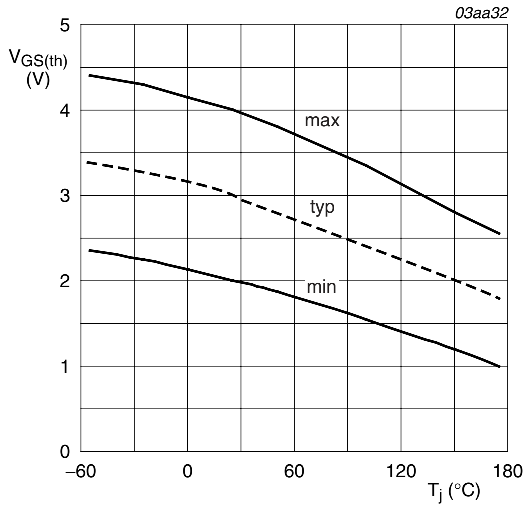
$T_j = 25°C; t_p = 300 \mu s$

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



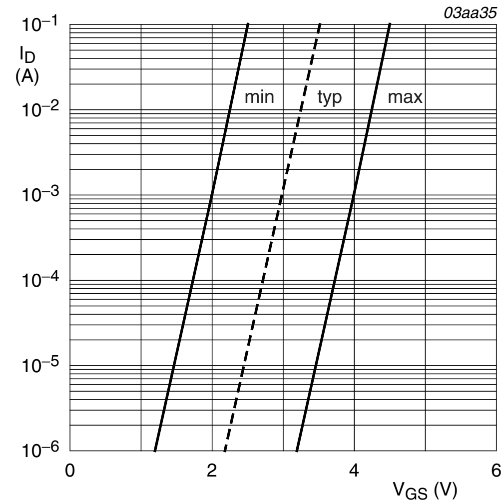
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



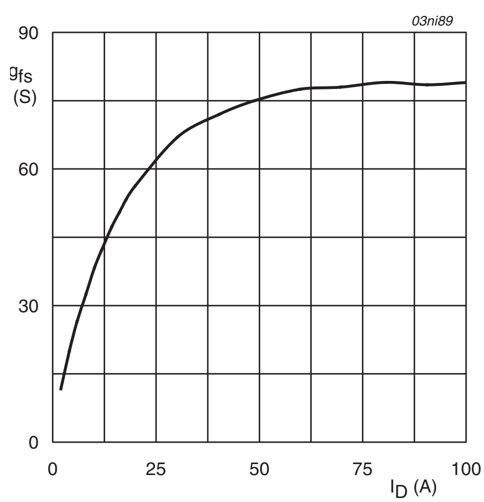
$I_D = 1mA; V_{DS} = V_{GS}$

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



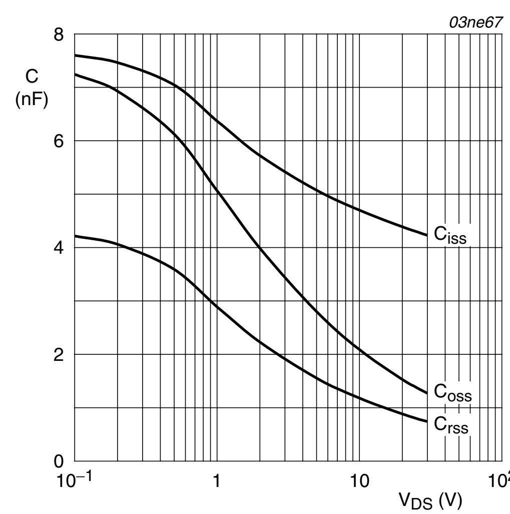
$T_j = 25\,°C; V_{DS} = 5V$

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



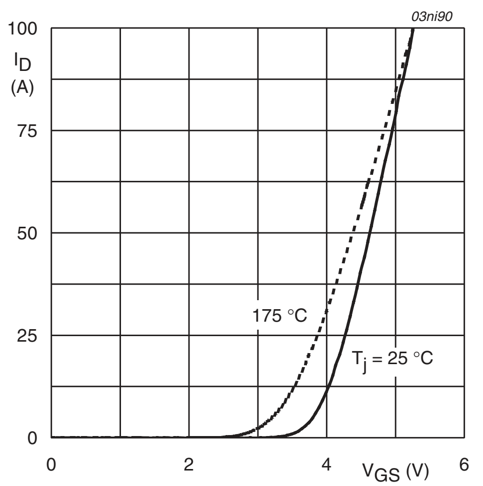
$T_j = 25°C; V_{DS} = 25V$

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



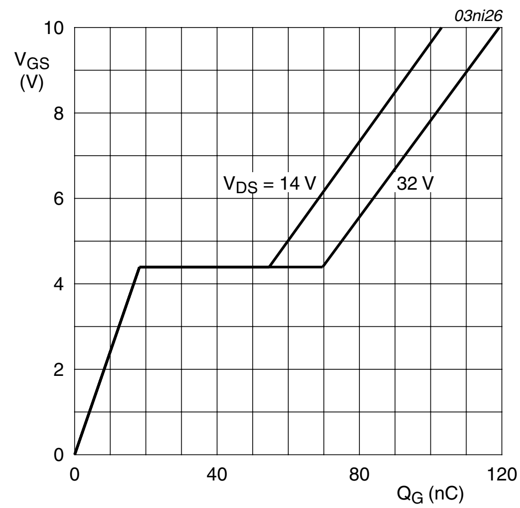
$V_{GS} = 0V; f = 1MHz$

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



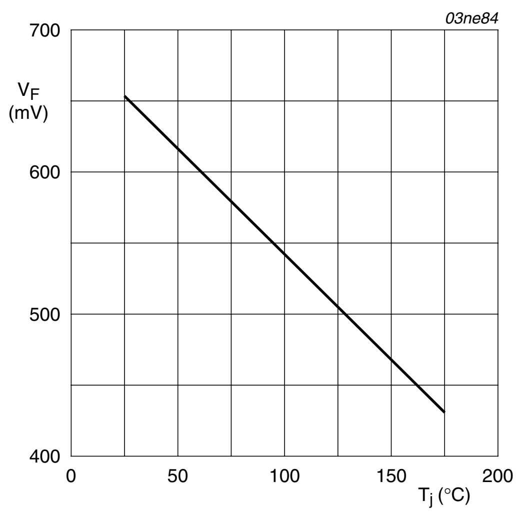
$V_{DS} = 25V$

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



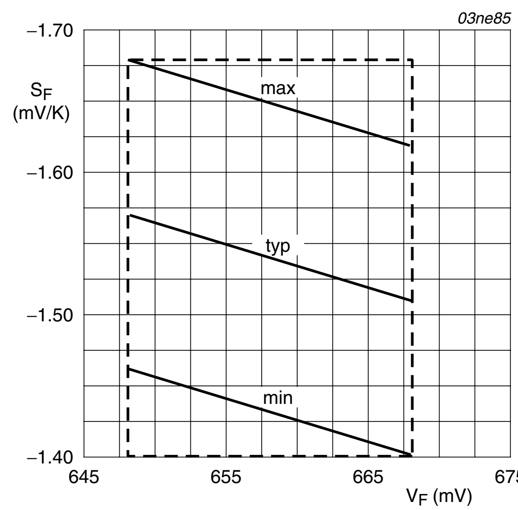
$T_j = 25°C; I_D = 25A$

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



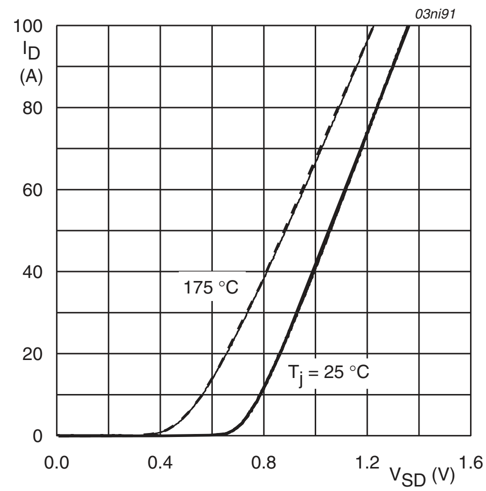
$I_F = 250\mu A$

Fig 15. 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 16. Temperature coefficient of temperature sense diode as a function of forward voltage; typical values

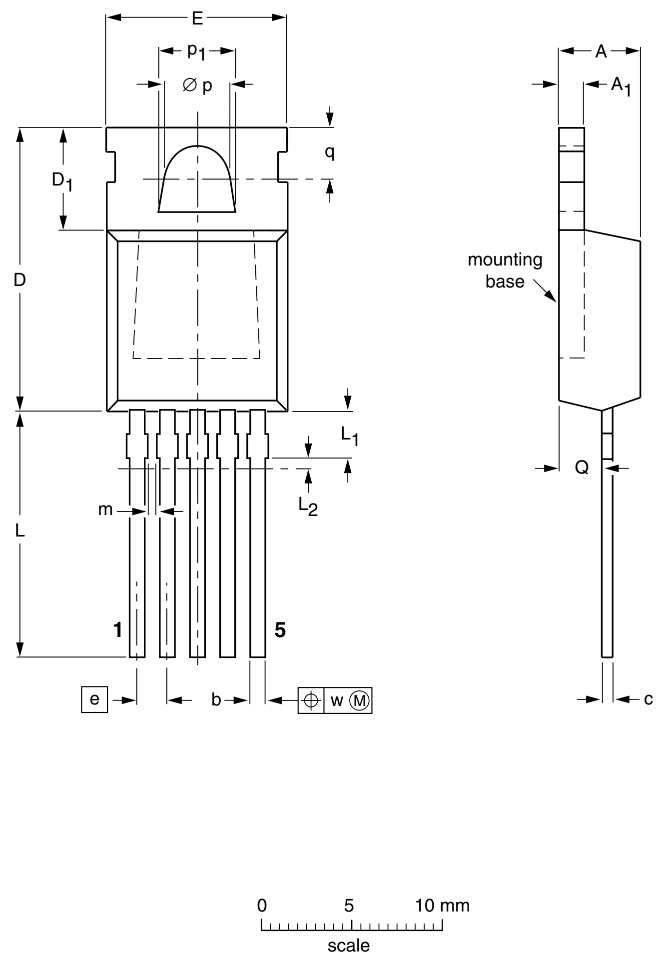


$$V_{GS} = 0V$$

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**



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.

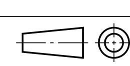
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT263B		5-lead TO-220				01-01-11

Fig 18. Package outline SOT263B (TO-220)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK7905-40ATE_2	20090210	Product data sheet	-	BUK71_7905_40ATE-01
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. • Type number BUK7905-40ATE separated from data sheet BUK71_7905_40ATE-01.			
BUK71_7905_40ATE-01 (9397 750 11694)	20030820	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.nexperia.com.

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11. Contents

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Date of release: 10 February 2009