BUK7Y13-40B

N-channel TrenchMOS standard level FET

Rev. 03 — 26 May 2008 **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 Nexperia High-Performance Automotive (HPA) TrenchMOS technology. This product has been designed and qualified to the appropriate AEC standard for use in automotive critical applications.

1.2 Features and benefits

- 175 °C rated
- Suitable for standard level gate drive sources
- Q101 compliant
- Suitable for thermally demanding environments due to 175 °C rating

1.3 Applications

- 12 V loads
- Automotive ABS systems
- Fuel pump and injection
- Air bag
- Automotive transmission control
- Motors, lamps and solenoids

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
I_D	drain current	$V_{GS} = 10$ V; $T_{mb} = 25$ °C; see Figure 1 and 4	-	-	58	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; see Figure 2	-	-	85	W
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 10$ A; $V_{DS} = 32$ V; $V_{GS} = 10$ V; see Figure 14	-	5	-	nC
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 25$ A; $T_j = 25$ °C; see Figure 13 and 12	-	11	13	mΩ
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 58$ A; $V_{sup} \leq 40$ V; $R_{GS} = 50$ Ω; $V_{GS} = 10$ V; $T_{j(init)} = 25$ °C; unclamped	-	-	85	mJ

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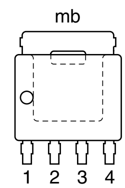
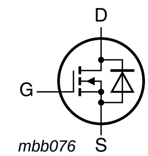
2. Pinning information

Table 2. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1, 2, 3	S	source	 SOT669 (LFPAK)	
4	G	gate		
mb	D	mounting base; connected to drain		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK7Y13-40B	LFPAK	plastic single-ended surface-mounted package (LFPAK); 4 leads	SOT669

4. Limiting values

Table 4. Limiting values

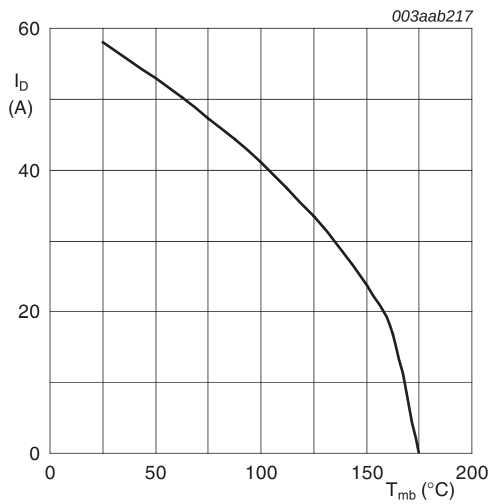
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	40	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20$ kΩ		-	40	V
V_{GS}	gate-source voltage			20	20	V
I_D	drain current	$T_{mb} = 25$ °C; $V_{GS} = 10$ V; see Figure 1 and 4		-	58	A
		$T_{mb} = 175$ °C; $V_{GS} = 10$ V; see Figure 1		-	41	A
I_{DM}	peak drain current	$T_{mb} = 25$ °C; $t_p \leq 10$ µs; pulsed; see Figure 4		-	234	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; see Figure 2		-	85	W
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 58$ A; $V_{sup} \leq 40$ V; $R_{GS} = 50$ Ω; $V_{GS} = 10$ V; $T_{j(init)} = 25$ °C; unclamped		-	85	mJ
$E_{DS(AL)R}$	repetitive drain-source avalanche energy	see Figure 3	[1][2][3]	-	-	J
Source-drain diode						
I_S	source current	$T_{mb} = 25$ °C		-	58	A
I_{SM}	peak source current	$t_p \leq 10$ µs; pulsed; $T_{mb} = 25$ °C		-	234	A

[1] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.

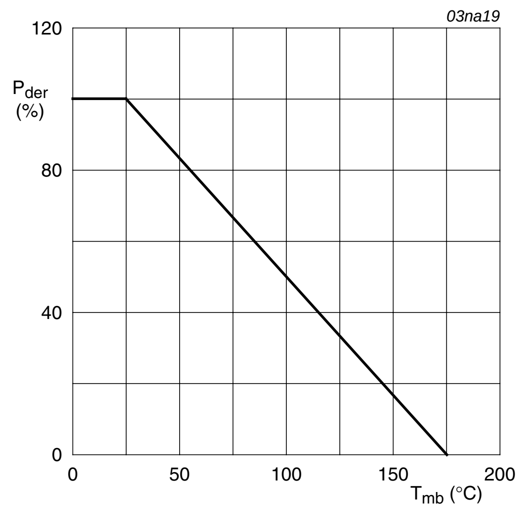
[2] Repetitive avalanche rating limited by an average junction temperature of 170 °C.

[3] Refer to application note AN10273 for further information.



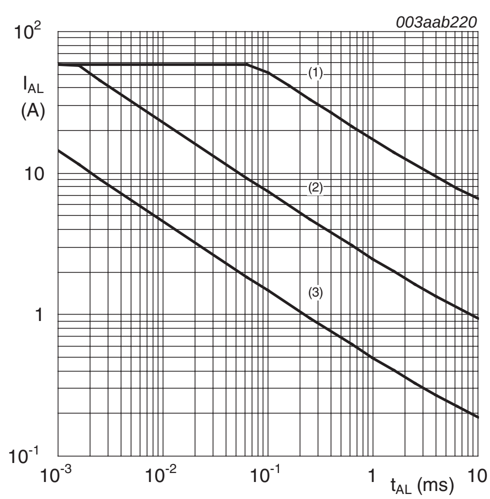
$V_{GS} \geq 10 V$

Fig 1. Continuous drain current as a function of mounting base temperature



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

Fig 2. Normalized total power dissipation as a function of mounting base temperature

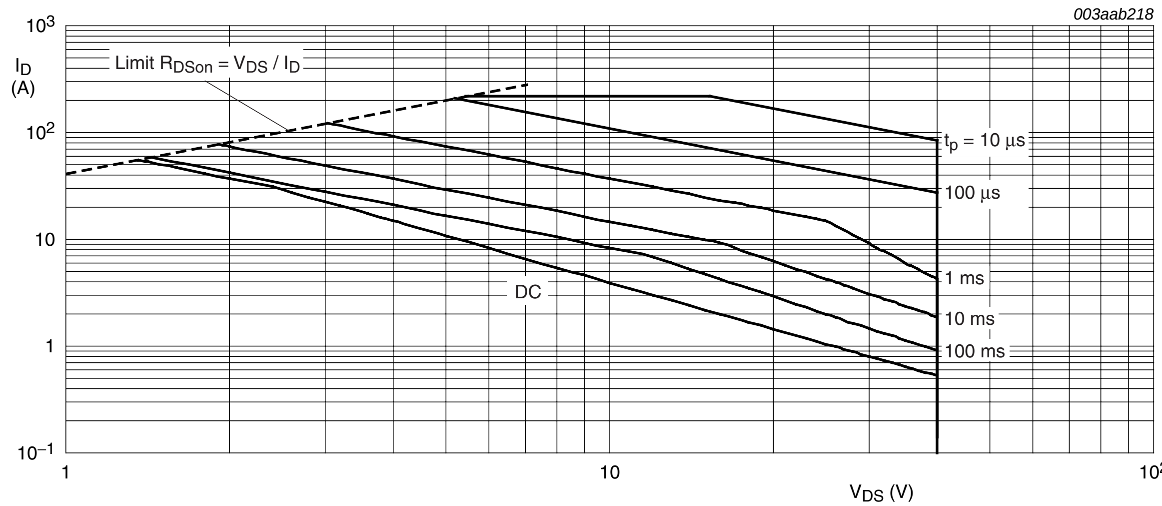


(1) Single−pulse; T_j = 25 °C.

(2) Single−pulse; T_j = 150 °C.

(3) Repetitive.

Fig 3. Single-shot and repetitive avalanche rating; avalanche current as a function of avalanche period



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

Fig 4. 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
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see Figure 5	-	-	1.8	K/W

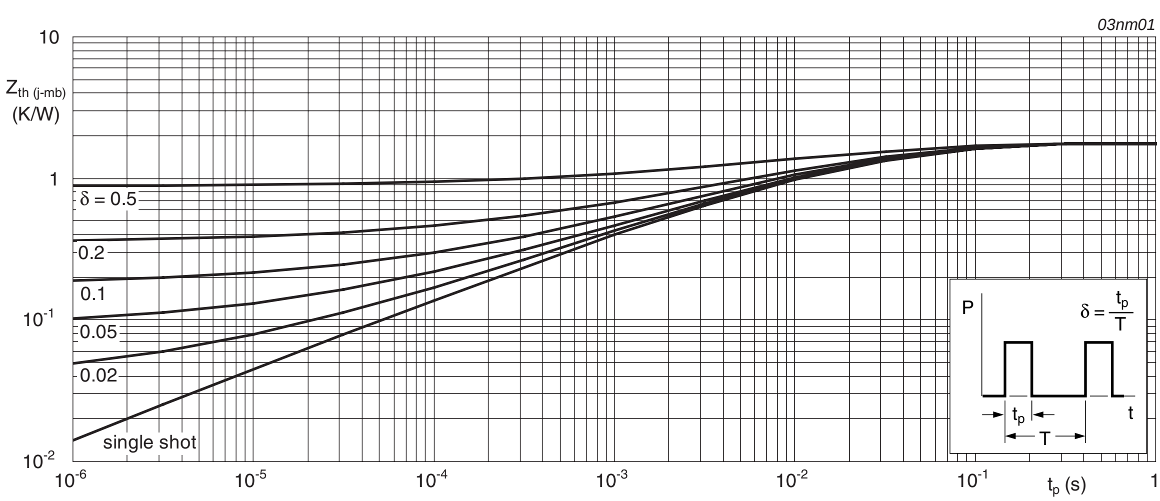
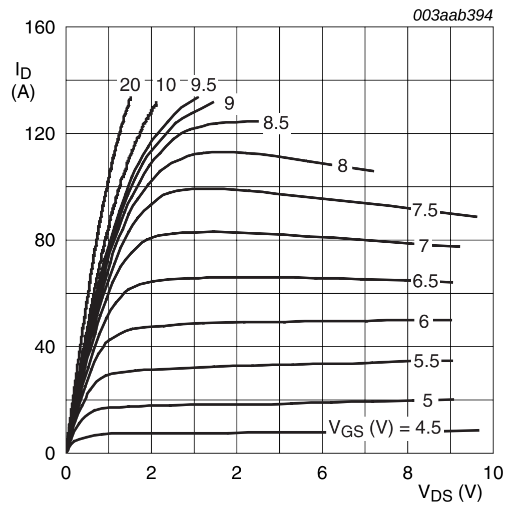


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

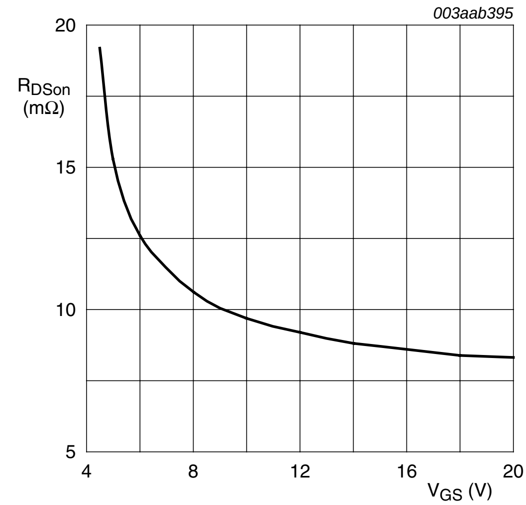
Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 μA; V_{GS} = 0 V; T_j = 25 °C	40	-	-	V
		I_D = 250 μA; 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 10 and 11	2	3	4	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; see Figure 10	-	-	4.4	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; see Figure 10	1	-	-	V
I_{DSS}	drain leakage current	V_{DS} = 40 V; V_{GS} = 0 V; T_j = 175 °C	-	-	500	μA
		V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 °C	-	0.02	1	μA
I_{GSS}	gate leakage current	V_{DS} = 0 V; V_{GS} = 20 V; T_j = 25 °C	-	2	100	nA
		V_{DS} = 0 V; V_{GS} = -20 V; T_j = 25 °C	-	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; see Figure 12	-	-	25	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; see Figure 13 and 12	-	11	13	mΩ
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 25 V; T_j = 25 °C; see Figure 16	-	0.85	1.2	V
t_{rr}	reverse recovery time	I_S = 20 A; dI_S/dt = 100 A/μs; V_{GS} = 0 V; V_{DS} = 30 V	-	41	-	ns
Q_r	recovered charge		-	22	-	nC
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 10 A; V_{DS} = 32 V; V_{GS} = 10 V; see Figure 14	-	19	-	nC
Q_{GS}	gate-source charge		-	6	-	nC
Q_{GD}	gate-drain charge		-	5	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; T_j = 25 °C; see Figure 15	-	983	1311	pF
C_{oss}	output capacitance		-	280	336	pF
C_{rss}	reverse transfer capacitance		-	138	189	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 2.5 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 10 Ω	-	9	-	ns
t_r	rise time		-	25	-	ns
$t_{d(off)}$	turn-off delay time		-	35	-	ns
t_f	fall time		-	27	-	ns



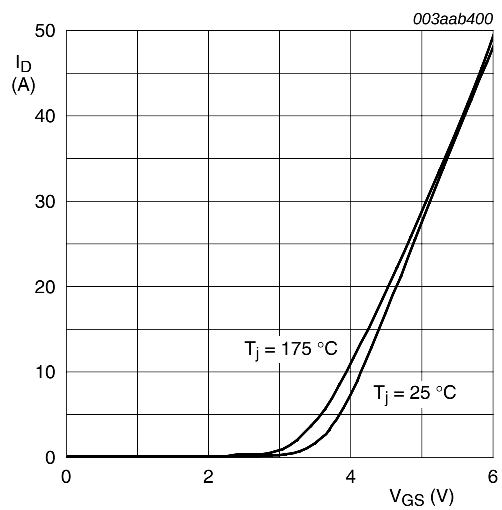
$T_j = 25\,°C$

Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values



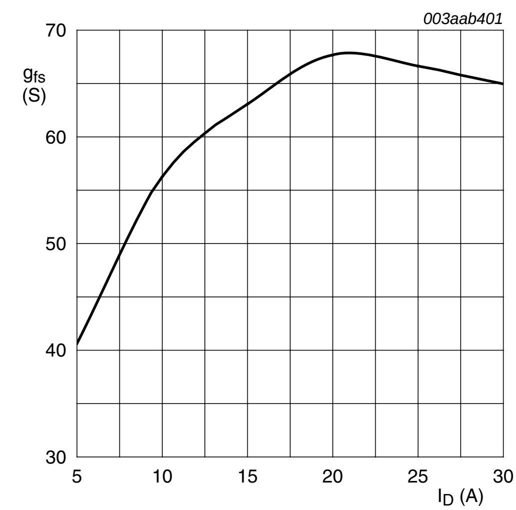
$T_j = 25\,°C$; $I_D = 25\,A$

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



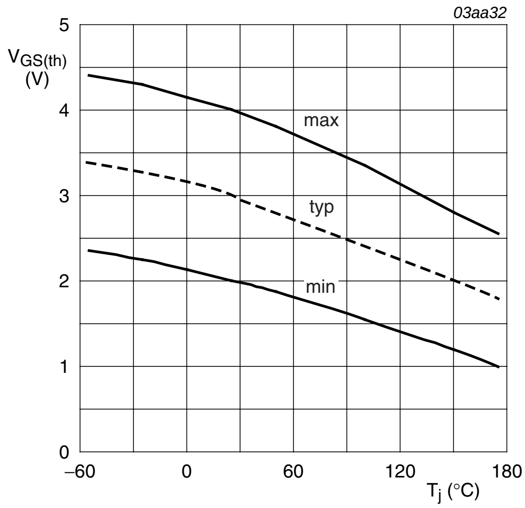
$V_{DS} = 25\,V$

Fig 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values



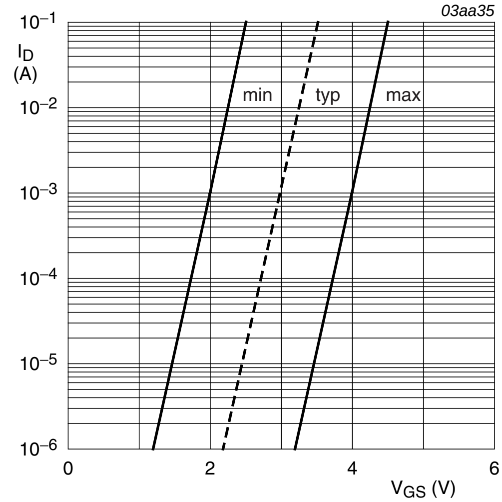
$T_j = 25\,°C$; $V_{DS} = 25\,V$

Fig 9. Forward transconductance as a function of drain current; typical values



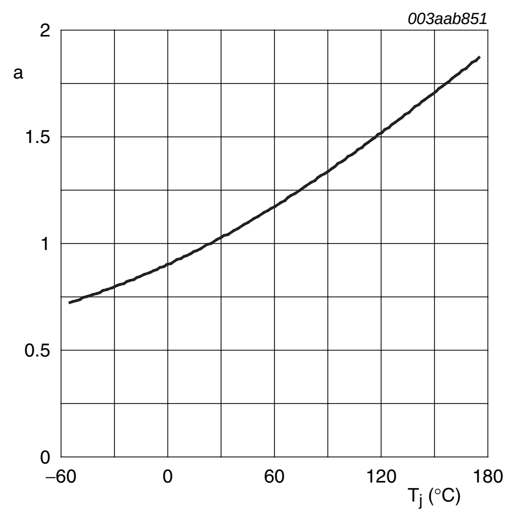
$I_D = 1\,mA; V_{DS} = V_{GS}$

Fig 10. Gate-source threshold voltage as a function of junction temperature



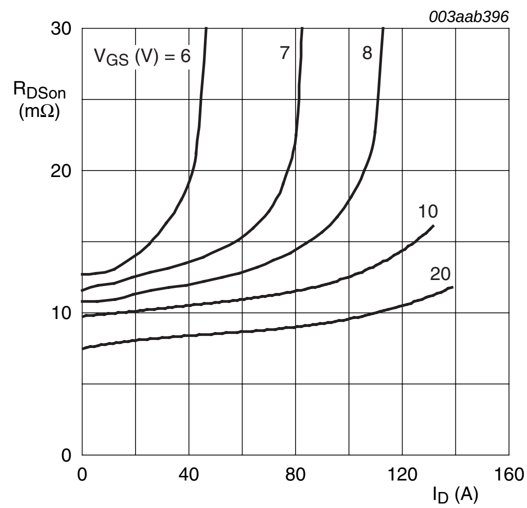
$T_j = 25\,°C; V_{DS} = V_{GS}$

Fig 11. Sub-threshold drain current as a function of gate-source voltage



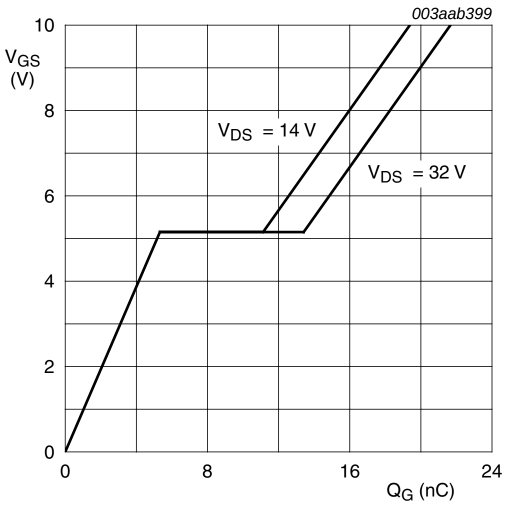
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

Fig 12. Normalized drain-source on-state resistance factor as a function of junction temperature



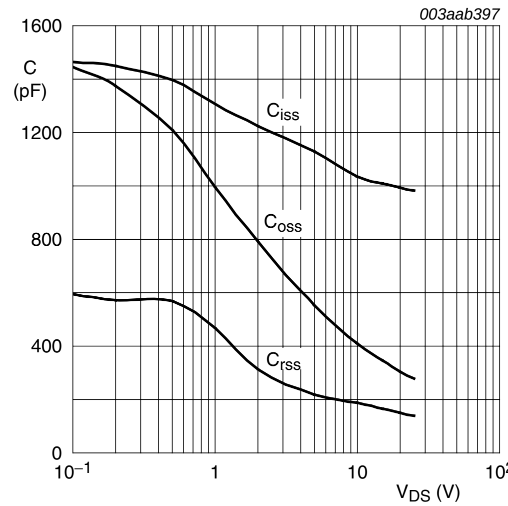
$T_j = 25\,°C$

Fig 13. Drain-source on-state resistance as a function of drain current; typical values



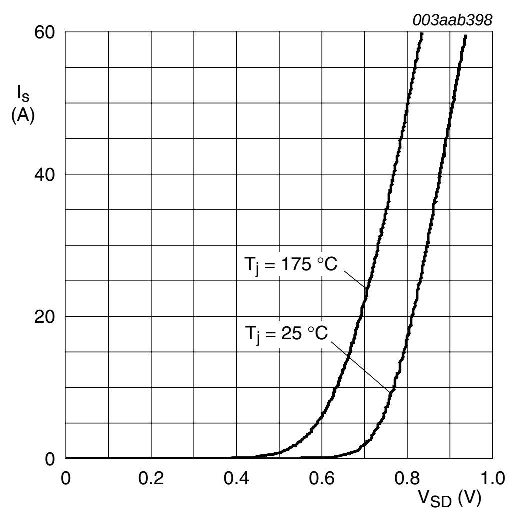
$T_j = 25\,°C; I_D = 10\,A$

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



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

Fig 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

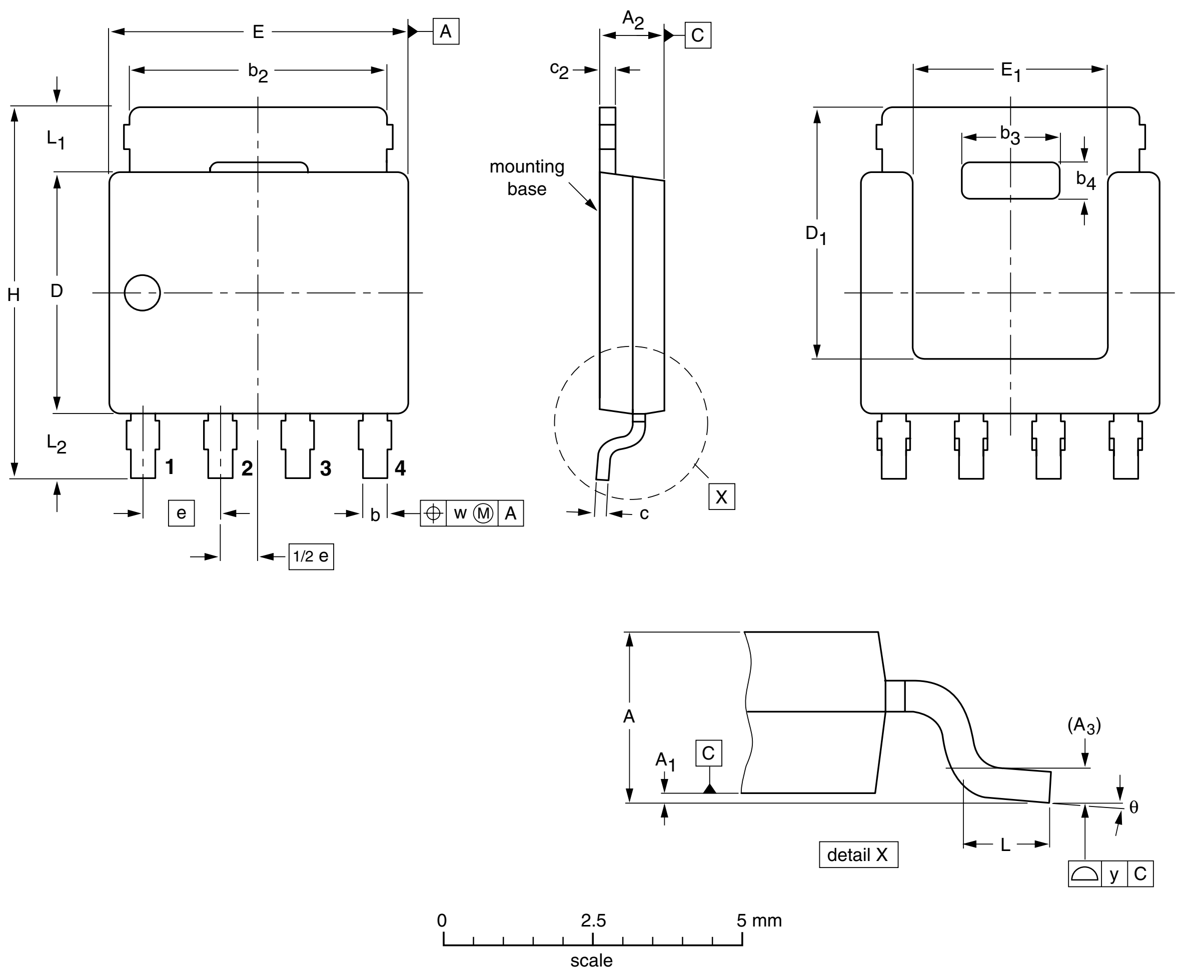


$V_{GS} = 0\,V$

Fig 16. Source current as a function of source-drain voltage; typical values

7. Package outline

Plastic single-ended surface-mounted package (LFPAK); 4 leads **SOT669**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	A_2	A_3	b	b_2	b_3	b_4	c	c_2	D(1)	D_1(1) max	E(1)	E_1(1)	e	H	L	L_1	L_2	w	y	θ
mm	1.20 1.01	0.15 0.00	1.10 0.95	0.25	0.50 0.35	4.41 3.62	2.2 2.0	0.9 0.7	0.25 0.19	0.30 0.24	4.10 3.80	4.20	5.0 4.8	3.3 3.1	1.27	6.2 5.8	0.85 0.40	1.3 0.8	1.3 0.8	0.25	0.1	8° 0°

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT669		MO-235				~~04-10-13~~ 06-03-16

Fig 17. Package outline SOT669 (LFPAK)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK7Y13-40B_3	20080526	Product data sheet	-	BUK7Y13-40B_2
Modifications:	• Table 5, maximum thermal resistance value updated			
BUK7Y13-40B_2	20071002	Product data sheet	-	BUK7Y13-40B_1
BUK7Y13-40B_1	20070924	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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