

BUK7C06-40AITE

N-channel TrenchMOS standard level FET

Rev. 04 — 23 June 2005

Product data sheet

1. Product profile

1.1 General description

N-channel enhancement mode power Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology, featuring very low on-state resistance and including TrenchPLUS current sensing, and diodes for ElectroStatic Discharge (ESD) and overtemperature protection.

1.2 Features

- Q101 compliant
- ESD protection
- Integrated temperature sensor
- Integrated current sensor

1.3 Applications

- Variable valve timing for engines
- Automotive and power switching
- Electrical power assisted steering
- Fan control

1.4 Quick reference data

- $V_{DS} \leq 40$ V
- $I_D \leq 155$ A
- $R_{DSon} = 4.7$ m Ω (typ)
- $V_F = 658$ mV (typ)
- $S_F = -1.54$ mV/K (typ)
- $I_D/I_{sense} = 615$ (typ)

2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	gate (G)	<p>SOT427 (D2PAK)</p>	<p>Kelvin source sym110</p>
2	I_{sense}		
3	anode (A)		
4	drain (D)		
5	cathode (K)		
6	kelvin source		
7	source (S)		
mb	mounting base; connected to drain (D)		

3. Ordering information

Table 2: Ordering information

Type number	Package		Version
	Name	Description	
BUK7C06-40AITE	D2PAK	Plastic single-ended surface mounted package; 7 leads (one lead cropped)	SOT427

4. Limiting values

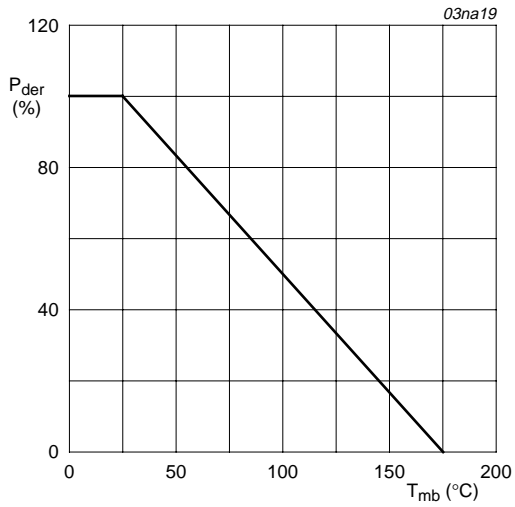
Table 3: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage		-	40	V
V_{DGR}	drain-gate voltage (DC)	$R_{GS} = 20 \text{ k}\Omega$	-	40	V
V_{GS}	gate-source voltage		-	± 20	V
I_D	drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$; $V_{GS} = 10 \text{ V}$; see Figure 2 and 3	[1]	155	A
			[2]	75	A
		$T_{mb} = 100 \text{ }^\circ\text{C}$; $V_{GS} = 10 \text{ V}$; see Figure 2	[2]	75	A
I_{DM}	peak drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$; pulsed; $t_p \leq 10 \text{ }\mu\text{s}$; see Figure 3	-	620	A
P_{tot}	total power dissipation	$T_{mb} = 25 \text{ }^\circ\text{C}$; see Figure 1	-	272	W
$I_{GS(CL)}$	gate-source clamping current	continuous	-	10	mA
		$t_p = 5 \text{ ms}$; $\delta = 0.01$	-	50	mA
$V_{isol(FET-TSD)}$	FET to temperature sense diode isolation voltage		-	± 100	V
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	$T_{mb} = 25 \text{ }^\circ\text{C}$	[1]	155	A
			[2]	75	A
I_{DRM}	peak reverse drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$; pulsed; $t_p \leq 10 \text{ }\mu\text{s}$	-	620	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 at $T_j = 25 \text{ }^\circ\text{C}$	-	1.46	J
Electrostatic discharge					
V_{esd}	electrostatic discharge voltage, pins 1, 2, 4, 6, 7	Human Body Model; $C = 100 \text{ pF}$; $R = 1.5 \text{ k}\Omega$	-	6	kV

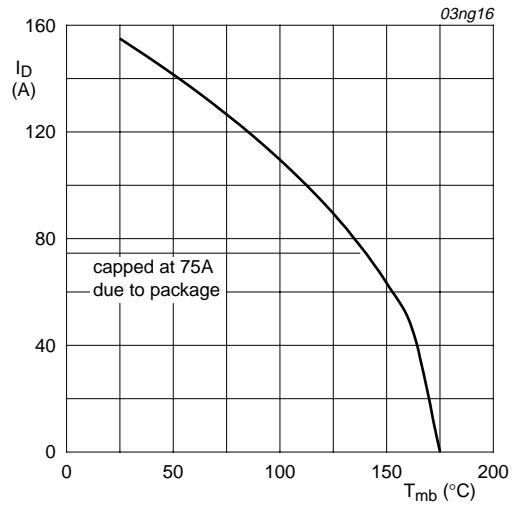
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.



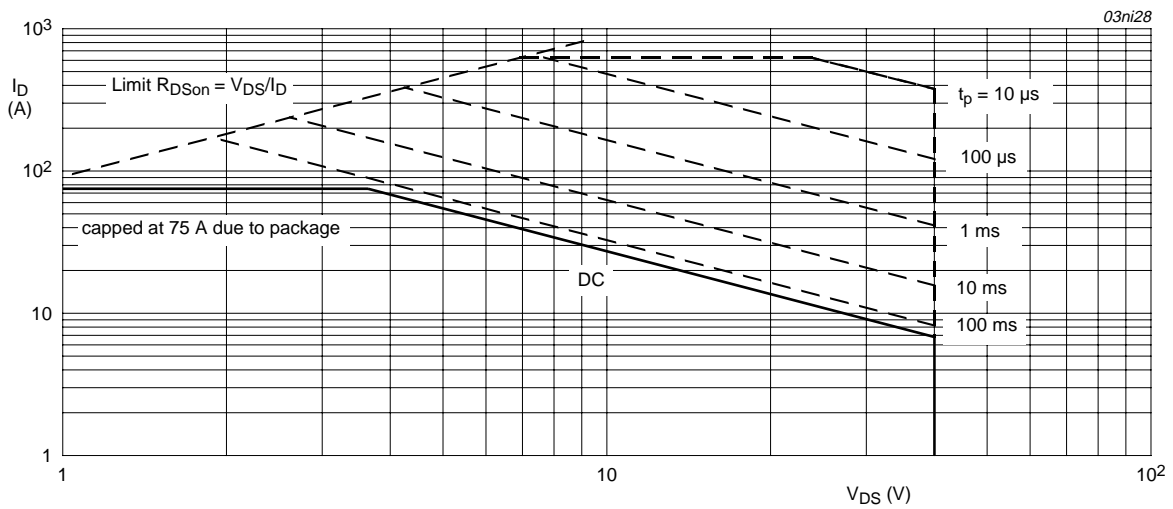
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ C)}} \times 100 \%$$

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

5. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	[1]	-	-	50	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see Figure 4	-	-	0.55	K/W

[1] Mounted on printed-circuit board; minimum footprint

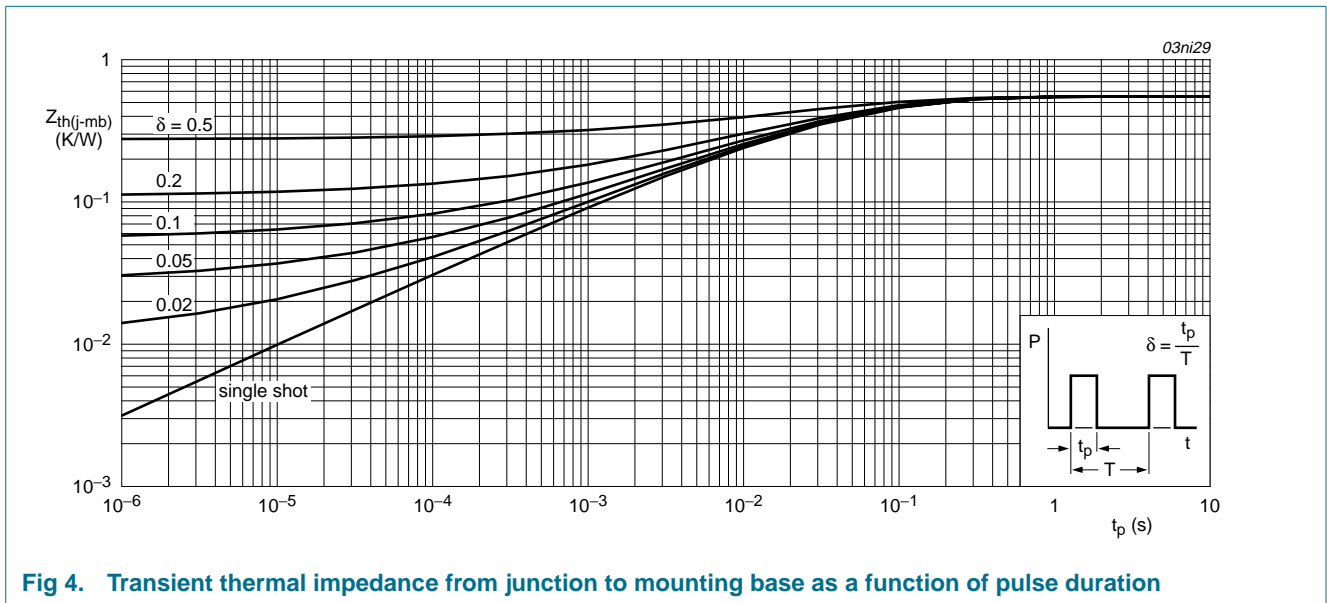


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

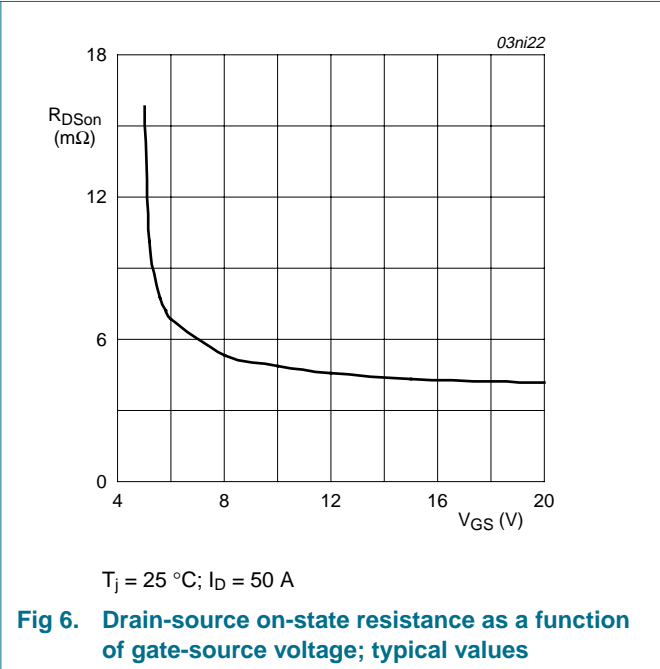
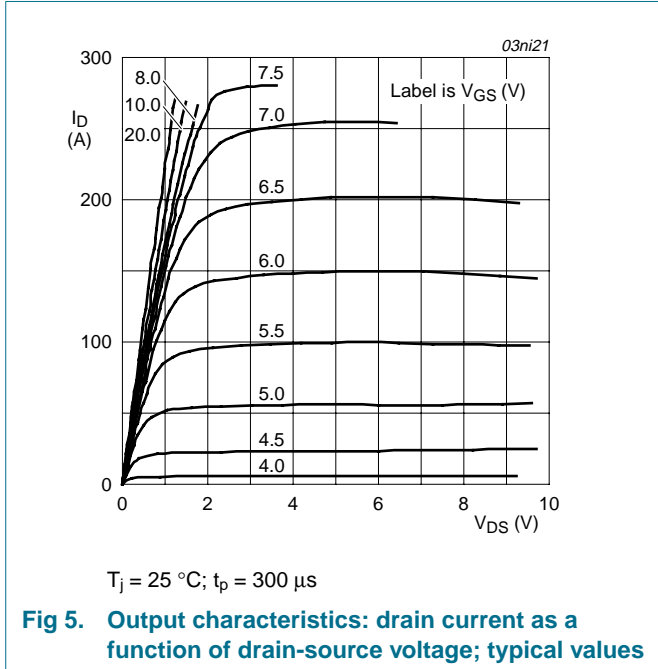
Table 5: Characteristics
 $T_j = 25\text{ °C}$ unless otherwise specified.

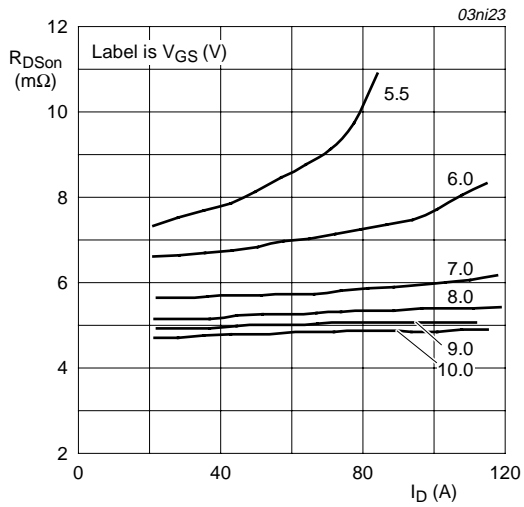
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25\text{ mA}; V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	40	-	-	V
		$T_j = -55\text{ °C}$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}; V_{DS} = V_{GS}$; see Figure 9				
		$T_j = 25\text{ °C}$	2	3	4	V
		$T_j = 175\text{ °C}$	1	-	-	V
		$T_j = -55\text{ °C}$	-	-	4.4	V
I_{DSS}	drain leakage current	$V_{DS} = 40\text{ V}; V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	-	0.1	10	μA
		$T_j = 175\text{ °C}$	-	-	250	μA
$V_{(BR)GSS}$	gate-source breakdown voltage	$I_G = \pm 1\text{ mA}; -55\text{ °C} < T_j < +175\text{ °C}$	20	22	-	V
I_{GSS}	gate leakage current	$V_{GS} = \pm 10\text{ V}; V_{DS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	-	22	1000	nA
		$T_j = 175\text{ °C}$	-	-	10	μA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 50\text{ A}$; see Figure 7 and 8				
		$T_j = 25\text{ °C}$	-	4.7	6	$\text{m}\Omega$
		$T_j = 175\text{ °C}$	-	-	11.4	$\text{m}\Omega$
V_F	forward voltage of temperature sense diode	$I_F = 250\text{ }\mu\text{A}$	648	658	668	mV
S_F	temperature coefficient of temperature sense diode	$I_F = 250\text{ }\mu\text{A}; -55\text{ °C} < T_j < +175\text{ °C}$	-1.4	-1.54	-1.68	mV/K
V_{hys}	forward voltage hysteresis of temperature sense diode	$125\text{ }\mu\text{A} < I_F < 250\text{ }\mu\text{A}$	25	32	50	mV
I_D/I_{sense}	ratio of drain current to sense current	$V_{GS} = 10\text{ V}; -55\text{ °C} < T_j < +175\text{ °C}$	585	615	645	
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$V_{GS} = 10\text{ V}; V_{DS} = 32\text{ V}; I_D = 25\text{ A}$; see Figure 14	-	120	-	nC
Q_{GS}	gate-source charge	$V_{GS} = 10\text{ V}; V_{DS} = 32\text{ V}; I_D = 25\text{ A}$; see Figure 14	-	19	-	nC
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}; V_{DS} = 32\text{ V}; I_D = 25\text{ A}$; see Figure 14	-	50	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz}$; see Figure 12	-	4300	-	pF
C_{oss}	output capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz}$; see Figure 12	-	1400	-	pF
C_{rss}	reverse transfer capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz}$; see Figure 12	-	820	-	pF

Table 5: Characteristics ...continued
 $T_j = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	turn-on delay time	$V_{DD} = 30\text{ V}$; $R_L = 1.2\ \Omega$; $V_{GS} = 10\text{ V}$; $R_G = 10\ \Omega$	-	35	-	ns
t_r	rise time	$V_{DD} = 30\text{ V}$; $R_L = 1.2\ \Omega$; $V_{GS} = 10\text{ V}$; $R_G = 10\ \Omega$	-	115	-	ns
$t_{d(off)}$	turn-off delay time	$V_{DD} = 30\text{ V}$; $R_L = 1.2\ \Omega$; $V_{GS} = 10\text{ V}$; $R_G = 10\ \Omega$	-	155	-	ns
t_f	fall time	$V_{DD} = 30\text{ V}$; $R_L = 1.2\ \Omega$; $V_{GS} = 10\text{ V}$; $R_G = 10\ \Omega$	-	110	-	ns
L_D	internal drain inductance	measured from upper edge of drain mounting base to center of die	-	2.5	-	nH
L_S	internal source inductance	measured from source lead to source bond pad	-	7.5	-	nH
V_{SD}	source-drain (diode forward) voltage	$I_S = 40\text{ A}$; $V_{GS} = 0\text{ V}$; see Figure 18	-	0.85	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = -10\text{ V}$; $V_{DS} = 30\text{ V}$	-	96	-	ns
Q_r	recovered charge	$I_S = 20\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = -10\text{ V}$; $V_{DS} = 30\text{ V}$	-	224	-	nC

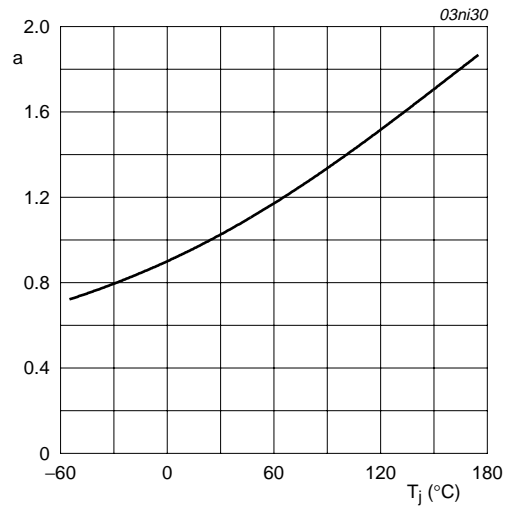
Source-drain diode





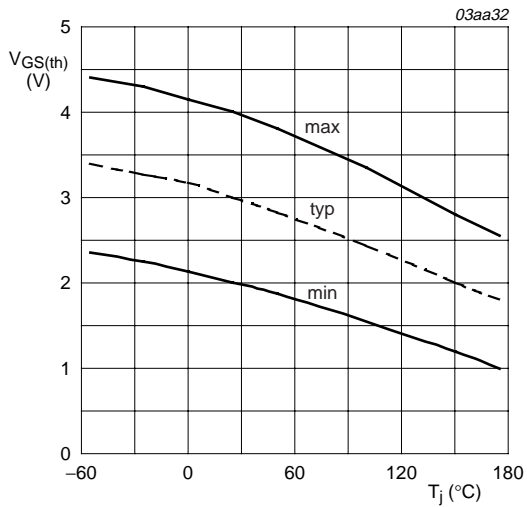
$T_j = 25^\circ\text{C}$; $t_p = 300 \mu\text{s}$

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



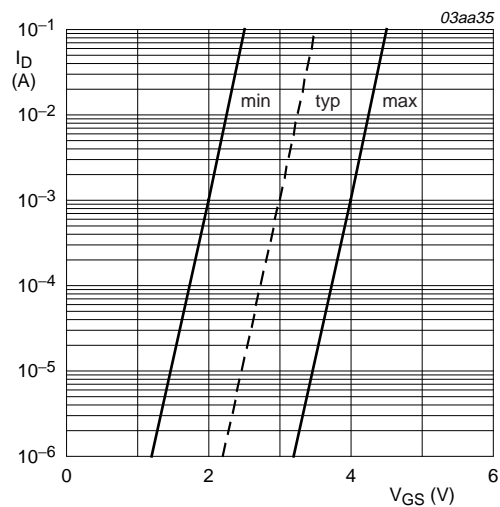
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



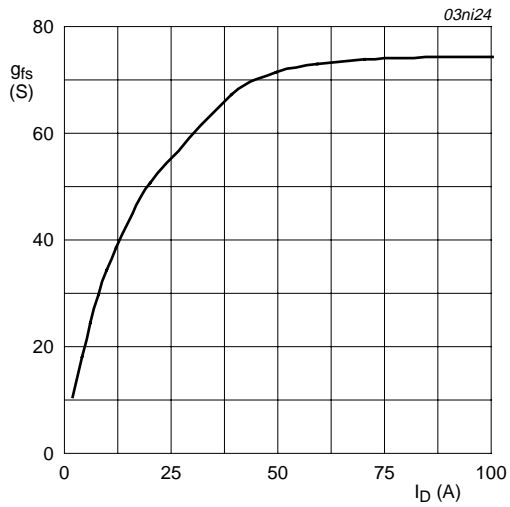
$I_D = 1 \text{ mA}$; $V_{DS} = V_{GS}$

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



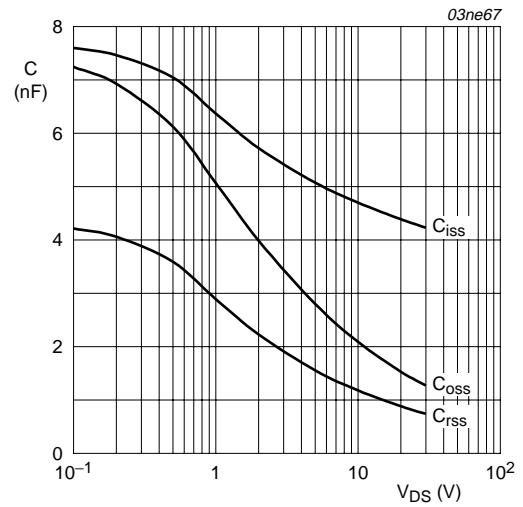
$T_j = 25^\circ\text{C}$; $V_{DS} = V_{GS}$

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



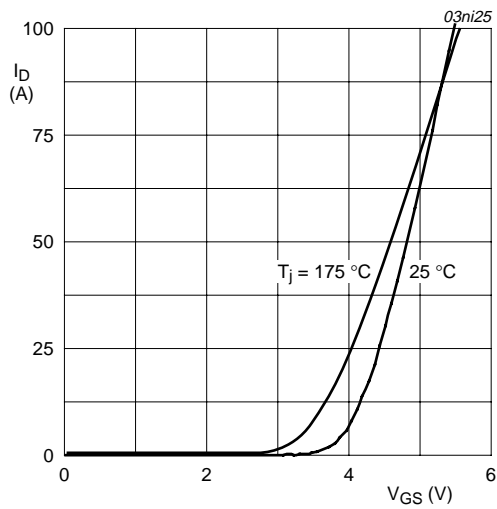
$T_j = 25\text{ }^\circ\text{C}; V_{DS} = 25\text{ V}$

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



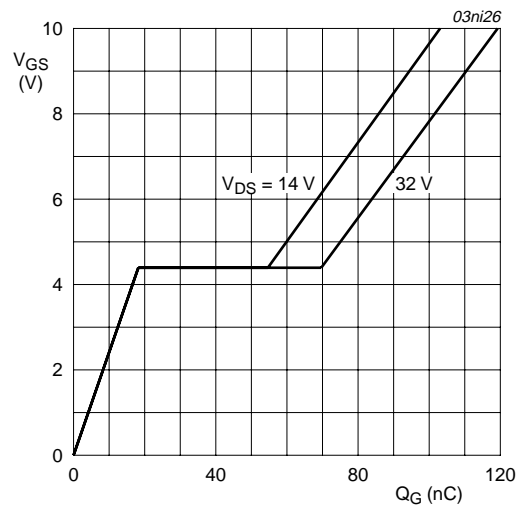
$V_{GS} = 0\text{ V}; f = 1\text{ MHz}$

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



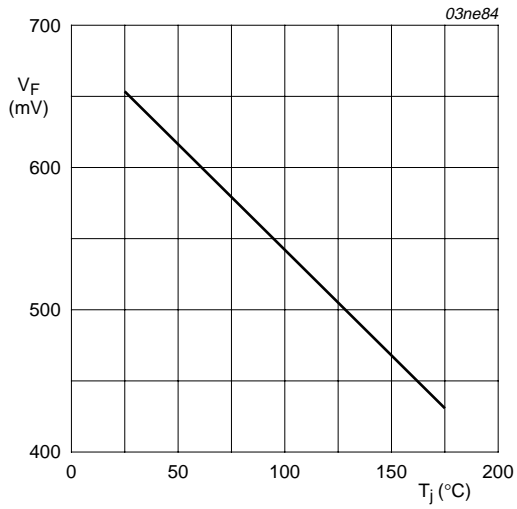
$V_{DS} = 25\text{ V}$

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



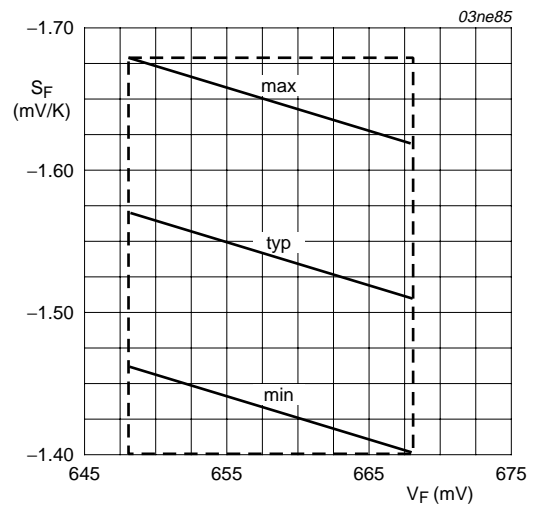
$T_j = 25\text{ }^\circ\text{C}; I_D = 25\text{ A}$

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



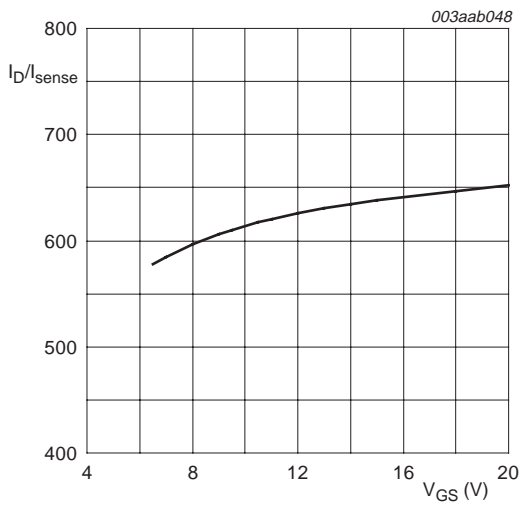
$I_F = 250 \mu A$

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



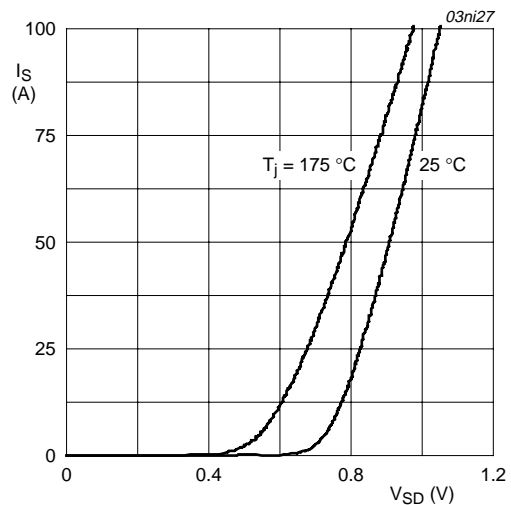
V_F at $T_j = 25 \text{ }^\circ\text{C}$; $I_F = 250 \mu A$

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



$I_D = 25 A$

Fig 17. Drain-sense current ratio as a function of gate voltage; typical values



$V_{GS} = 0 V$

Fig 18. Source (diode forward) current as function of source-drain (diode forward) voltage; typical values

7. Package outline

Plastic single-ended surface mounted package (D2PAK); 7 leads (one lead cropped)

SOT427

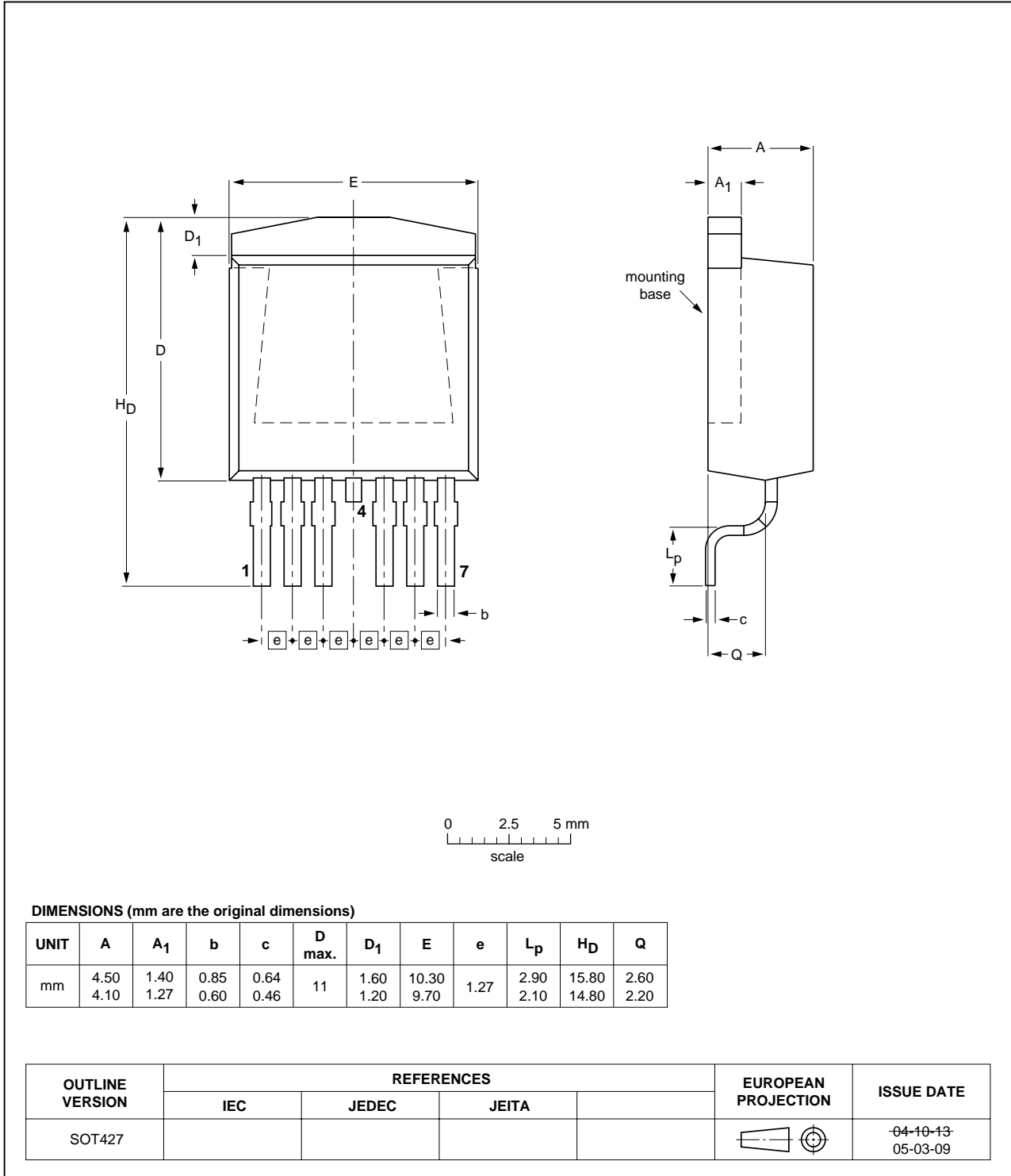
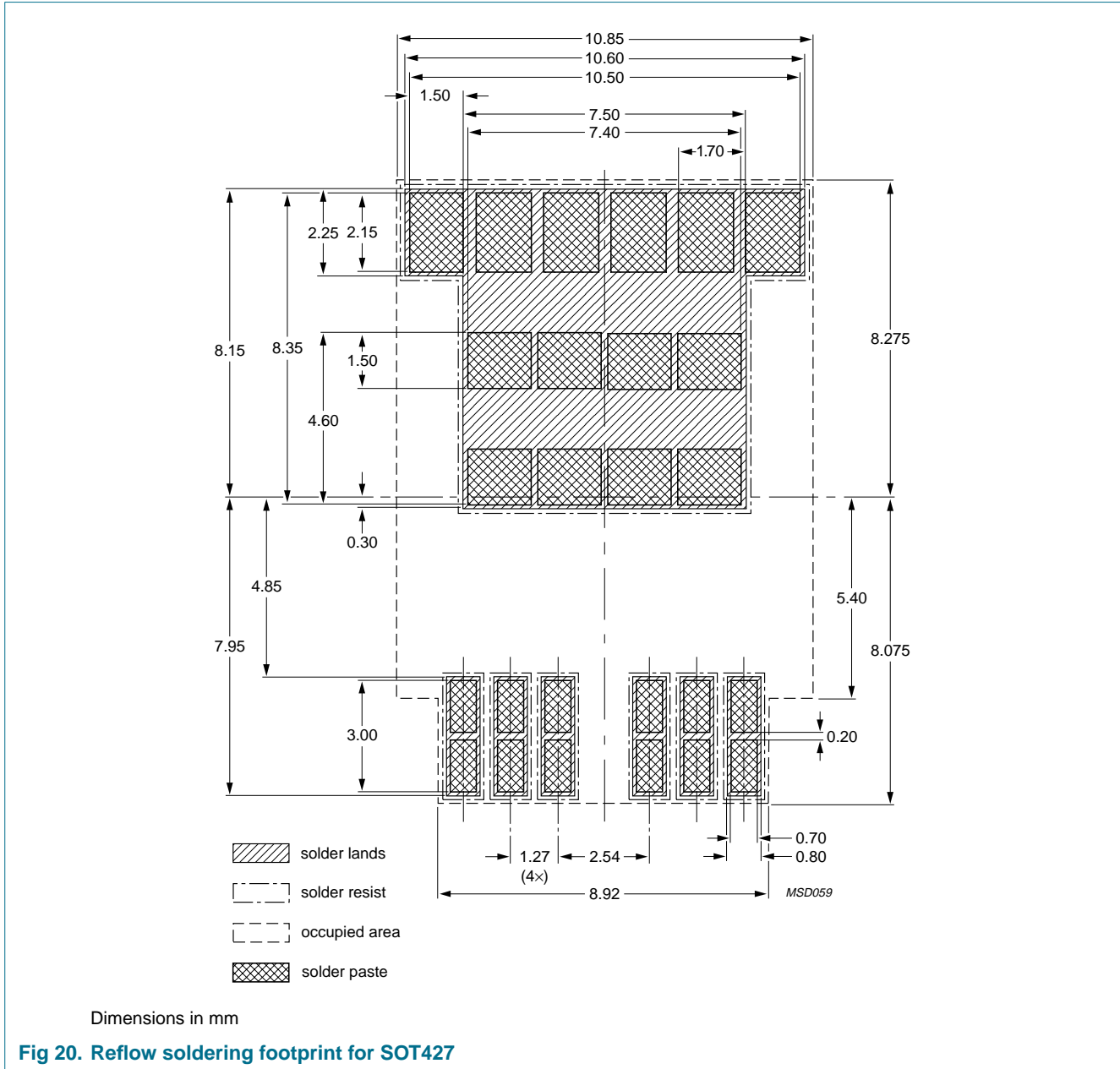


Fig 19. Package outline SOT427 (D2PAK)

8. Soldering



9. Revision history

Table 6: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
BUK7C06-40AITE_4	20050623	Product data sheet	-	-	BUK7C06-40AITE_3
Modifications:	<ul style="list-style-type: none"> • Figure 16: graph corrected 				
BUK7C06-40AITE_3	20050616	Product data sheet	-	9397 750 15176	BUK7C06_40AITE-02
Modifications:	<ul style="list-style-type: none"> • The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors. • Section 1 “Product profile” and Table 5: I_D/I_{sense} values changed. • Figure 17: graph changed. 				
BUK7C06_40AITE-02	20040129	Product data	-	9397 750 12487	BUK7C06_40AITE-01
Modifications:	<ul style="list-style-type: none"> • Section 3 “Ordering information” added • Section 1 and Table 5: R_{DSon} typical value changed • Section 1 and Table 5: I_D/I_{sense} typical value changed • Table 5: $Q_{g(tot)}$, Q_{gs} and Q_{gd} typical values changed • Table 5: C_{iss}, C_{oss} and C_{rss} typical values changed • Figure 5, 6, 7, 11, 13, 17, 18: graphs changed 				
BUK7C06_40AITE-01	20020717	Product data	-	9397 750 09873	-

10. 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.
II	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.
III	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. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

[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>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

11. 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.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

12. Disclaimers

Life support — These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors

14. Contact information

For additional information, please visit: <http://www.semiconductors.philips.com>

For sales office addresses, send an email to: sales.addresses@www.semiconductors.philips.com

customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes in the products - including circuits, standard cells, and/or software - described or contained herein in order to improve design and/or performance. When the product is in full production (status 'Production'), relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

13. Trademarks

Notice — All referenced brands, product names, service names and trademarks are the property of their respective owners.

TrenchMOS — is a trademark of Koninklijke Philips Electronics N.V.

15. Contents

1	Product profile	1
1.1	General description.	1
1.2	Features	1
1.3	Applications	1
1.4	Quick reference data.	1
2	Pinning information	1
3	Ordering information	2
4	Limiting values	2
5	Thermal characteristics	4
6	Characteristics	5
7	Package outline	10
8	Soldering	11
9	Revision history	12
10	Data sheet status	13
11	Definitions	13
12	Disclaimers	13
13	Trademarks	13
14	Contact information	13



© Koninklijke Philips Electronics N.V. 2005

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Date of release: 23 June 2005
Document number: BUK7C06-40AITE_4

Published in The Netherlands