

BUK7C08-55AITE

TrenchPLUS standard level FET

Rev. 01 — 19 August 2003

Product data

1. Product profile

1.1 Description

N-channel enhancement mode field-effect power transistor in a plastic package using TrenchMOS™ technology, featuring very low on-state resistance and including TrenchPLUS current sensing, and diodes for ESD and overtemperature protection.

Product availability:

BUK7C08-55AITE in SOT427 (D²-PAK).

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

- $V_{DS} \leq 55 \text{ V}$
- $I_D \leq 130 \text{ A}$
- $R_{DSon} = 6.8 \text{ m}\Omega$ (typ)
- $V_F = 658 \text{ mV}$ (typ)
- $S_F = -1.54 \text{ mV/K}$ (typ)
- $I_D/I_{sense} = 500$ (typ).

2. Pinning information

Table 1: Pinning - SOT427, simplified outline and symbol

Pin	Description	Pin	Description	Simplified outline	Symbol
1	gate (g)	5	cathode (k)		
2	I_{sense}	6	Kelvin source		
3	anode (a)	7	source (s)		
4	drain (d)				
mb	mounting base; connected to drain (d)				

SOT427 (D²-PAK)



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3. Limiting values

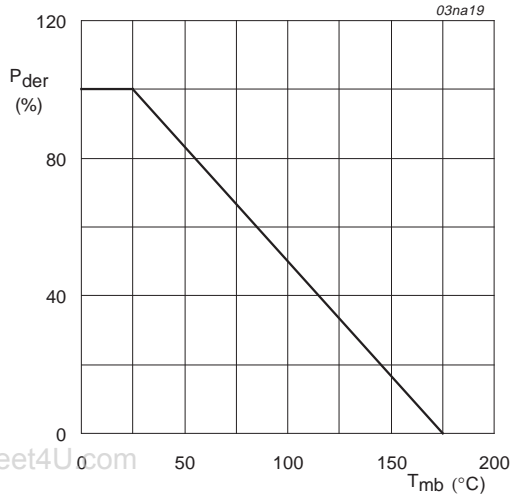
Table 2: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)		-	55	V
V_{DGR}	drain-gate voltage (DC)	$R_{GS} = 20 \text{ k}\Omega$	-	55	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] -	130	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	-	522	A
P_{tot}	total power dissipation	$T_{mb} = 25 \text{ }^\circ\text{C}$; 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 (DC)	$T_{mb} = 25 \text{ }^\circ\text{C}$	[1] -	130	A
			[2] -	75	A
I_{DRM}	peak reverse drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$; pulsed; $t_p \leq 10 \text{ }\mu\text{s}$	-	522	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive avalanche energy	unclamped inductive load; $I_D = 75 \text{ A}$; $V_{DS} \leq 55 \text{ V}$; $V_{GS} = 10 \text{ V}$; $R_{GS} = 50 \text{ }\Omega$; starting $T_j = 25 \text{ }^\circ\text{C}$	-	460	mJ
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

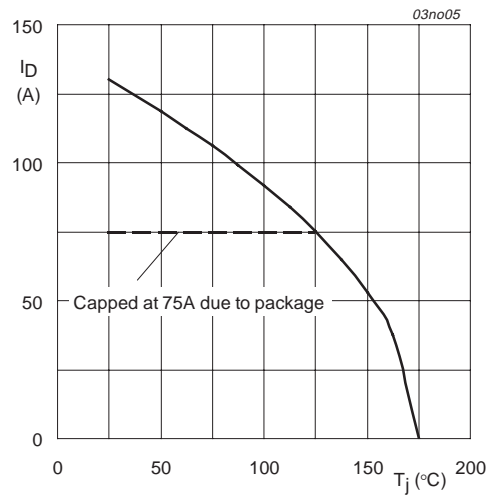
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.



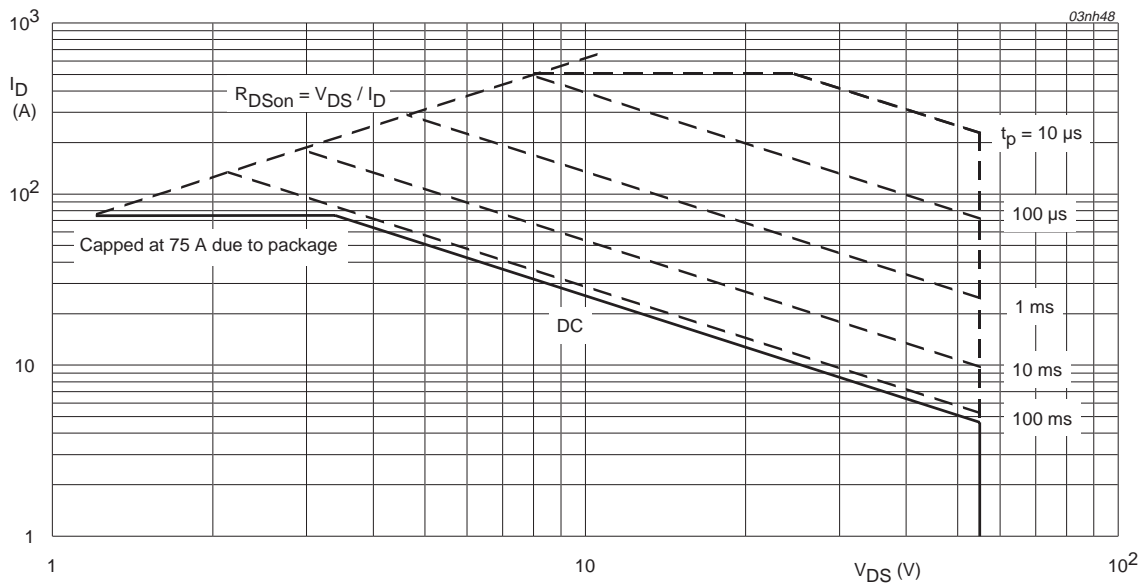
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



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

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
$R_{th(j-a)}$	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	Figure 4	-	-	0.55	K/W

4.1 Transient thermal impedance

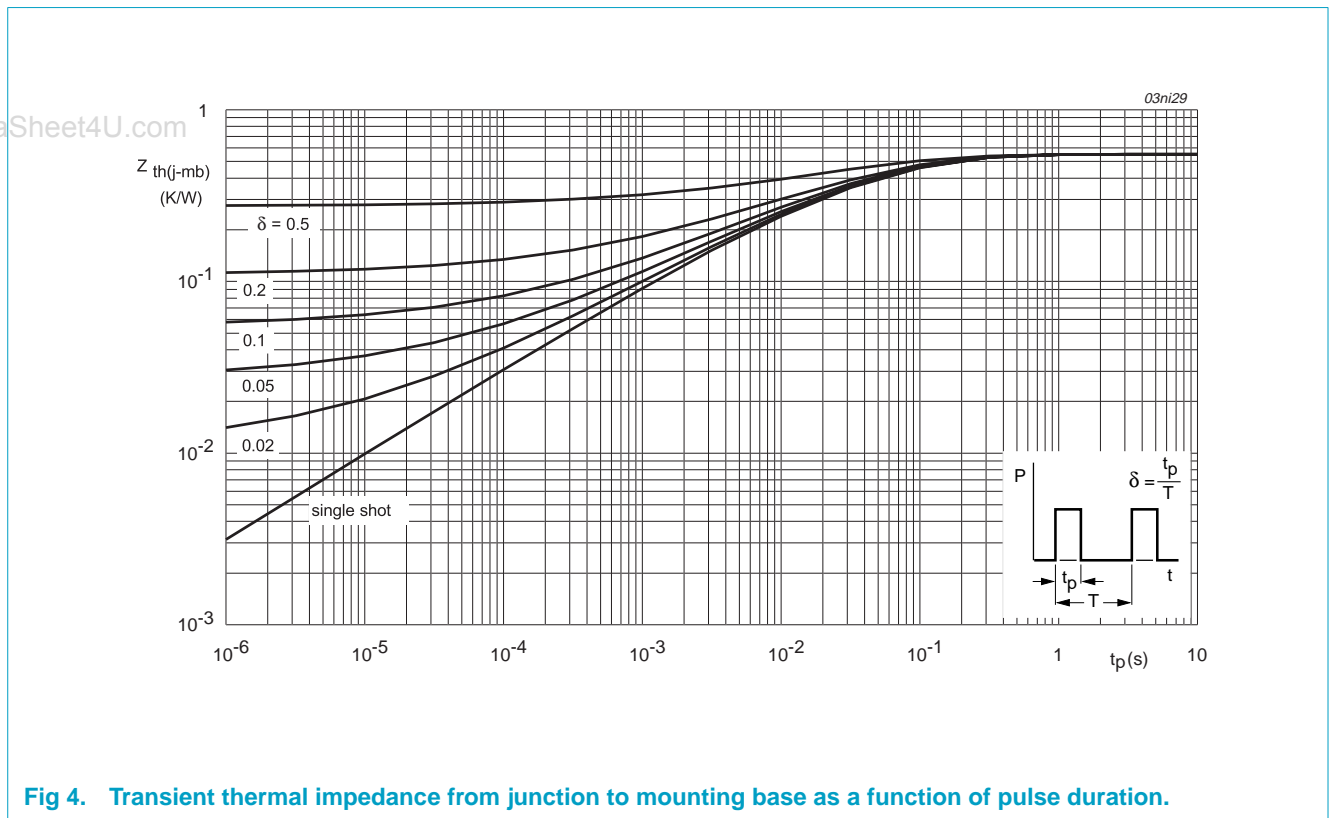


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

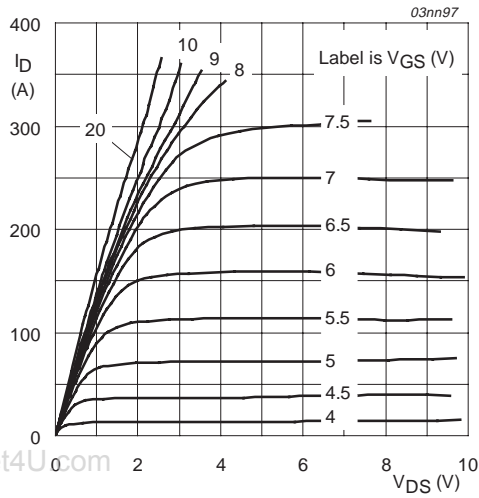
5. Characteristics

Table 4: Characteristics
 $T_j = 25\text{ °C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25\text{ mA}; V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	55	-	-	V
		$T_j = -55\text{ °C}$	50	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}; V_{DS} = V_{GS};$ 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-source 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-source 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	$V_{GS} = 10\text{ V}; I_D = 50\text{ A};$ Figure 7 and 8				
		$T_j = 25\text{ °C}$	-	6.8	8	m Ω
		$T_j = 175\text{ °C}$	-	-	16	m Ω
$R_{D(I_s)on}$	drain- I_{sense} on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ mA};$ Figure 18				
		$T_j = 25\text{ °C}$	1.32	1.55	1.82	Ω
		$T_j = 175\text{ °C}$	3.04	3.57	4.19	Ω
V_F	forward voltage temperature sense diode	$I_F = 250\text{ }\mu\text{A}$	648	658	668	mV
S_F	temperature coefficient 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 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	$V_{GS} > 5\text{ V};$ $-55\text{ °C} < T_j < +175\text{ °C}$	450	500	550	-
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	$V_{GS} = 10\text{ V}; V_{DS} = 44\text{ V};$	-	116	-	nC
Q_{gs}	gate-source charge	$I_D = 25\text{ A};$ Figure 14	-	19	-	nC
Q_{gd}	gate-drain (Miller) charge		-	51	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V};$	-	4200	-	pF
C_{oss}	output capacitance	$f = 1\text{ MHz};$ Figure 12	-	920	-	pF
C_{rss}	reverse transfer capacitance		-	500	-	pF

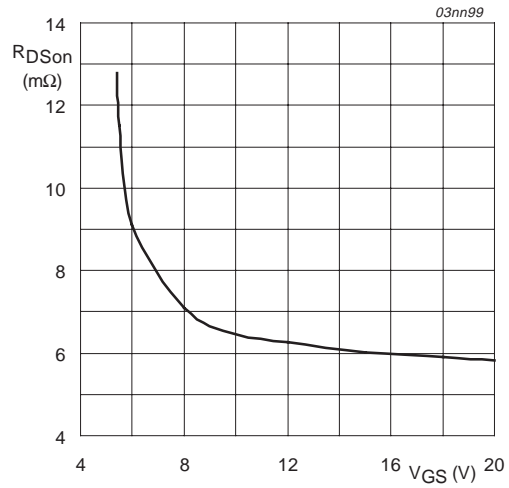
Table 4: Characteristics...continued $T_j = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	turn-on delay time	$V_{DD} = 30\text{ V}; R_L = 1.2\ \Omega;$	-	35	-	nS
t_r	rise time	$V_{GS} = 10\text{ V}; R_G = 10\ \Omega$	-	115	-	nS
$t_{d(off)}$	turn-off delay time		-	155	-	nS
t_f	fall time		-	110	-	nS
L_d	internal drain inductance	measured from upper edge of drain mounting base to centre of die	-	2.5	-	nH
L_s	internal source inductance	measured from source lead to source bond pad; lead length 6 mm	-	7.5	-	nH
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	$I_S = 40\text{ A}; V_{GS} = 0\text{ V};$ Figure 19	-	0.85	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}; dI_S/dt = -100\text{ A}/\mu\text{s}$	-	80	-	ns
Q_r	recovered charge	$V_{GS} = -10\text{ V}; V_{DS} = 30\text{ V}$	-	200	-	nC



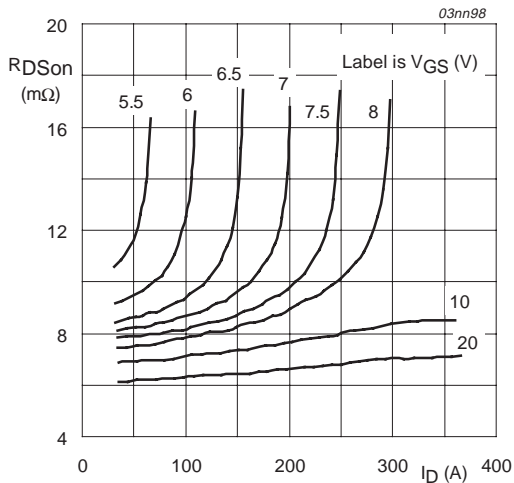
$T_j = 25\text{ }^\circ\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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



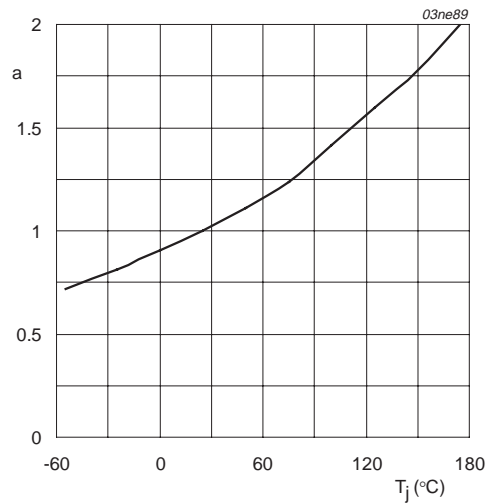
$T_j = 25\text{ }^\circ\text{C}$; $I_D = 50\text{ A}$

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



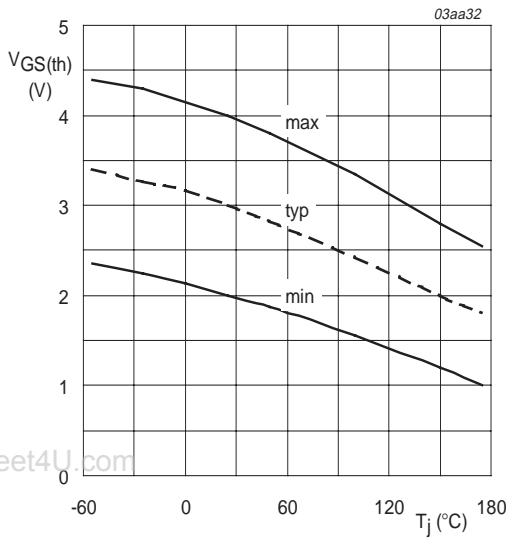
$T_j = 25\text{ }^\circ\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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



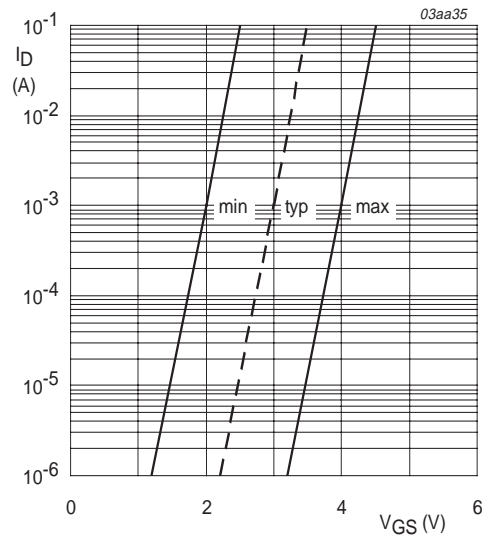
$$a = \frac{R_{DSon}}{R_{DSon}(25\text{ }^\circ\text{C})}$$

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



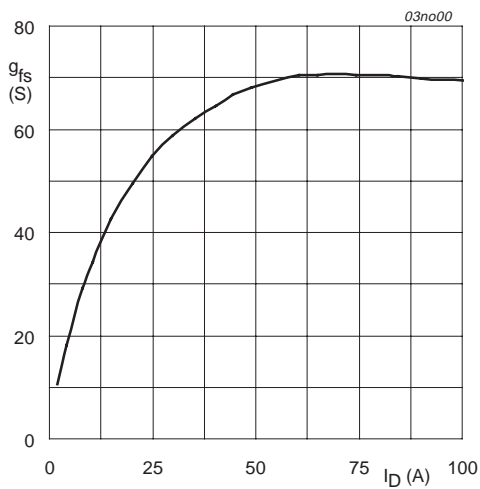
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



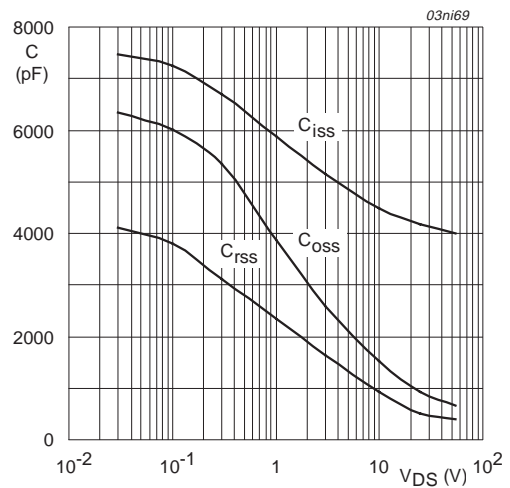
$T_j = 25 \text{ }^{\circ}C; V_{DS} = V_{GS}$

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



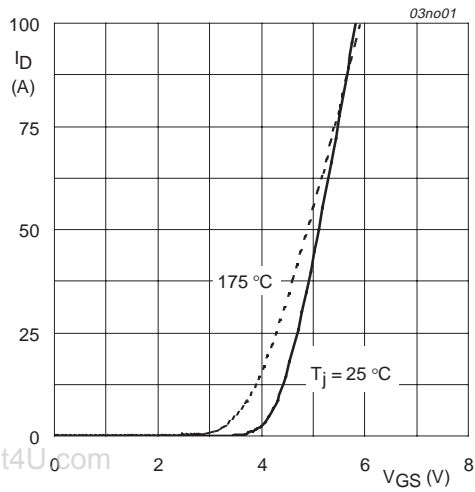
$T_j = 25 \text{ }^{\circ}C; V_{DS} = 25 \text{ V}$

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



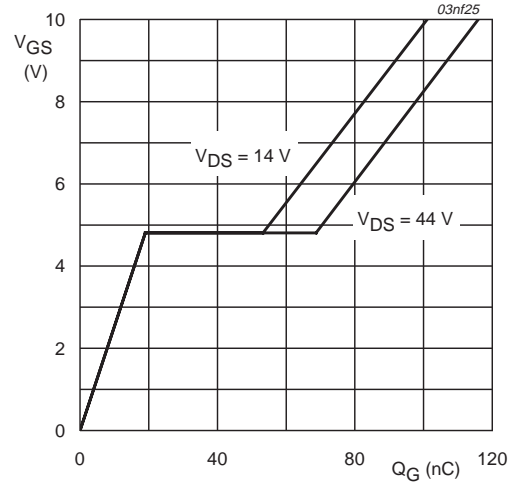
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



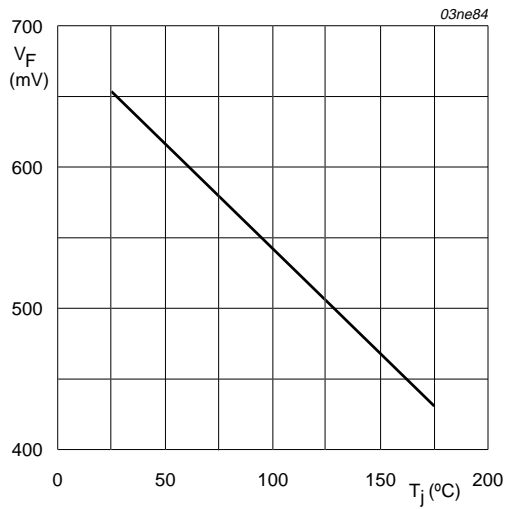
$V_{DS} = 25\text{ V}$

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



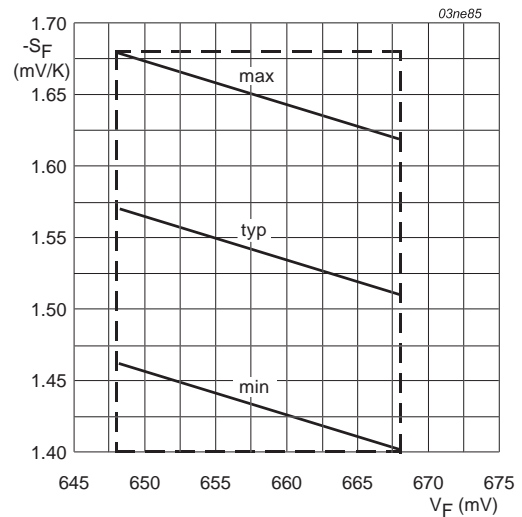
$T_j = 25\text{ °C}; I_D = 25\text{ A}$

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



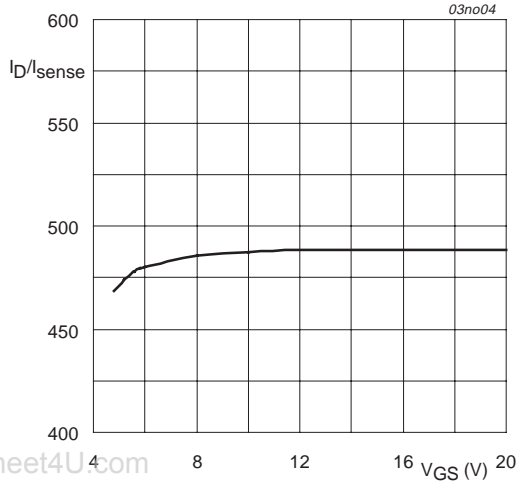
$I_F = 250\text{ }\mu\text{A}$

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



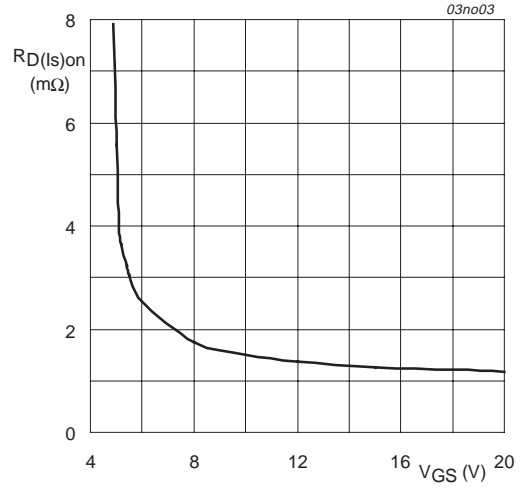
V_F at $T_j = 25\text{ °C}; I_F = 250\text{ }\mu\text{A}$

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



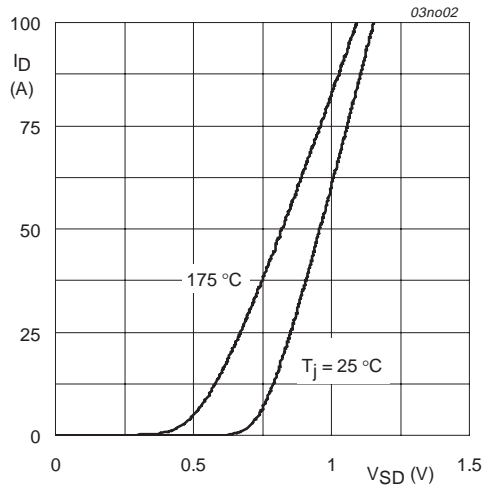
$I_D = 25 \text{ A}$

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



$I_{\text{sense}} = 25 \text{ mA}$

Fig 18. $R_{D(I_{\text{sense}})_{\text{on}}}$ as function of gate-source voltage; typical values.



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

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

6. Package outline

Plastic single-ended surface mounted package (Philips version of D²-PAK);
7 leads (one lead cropped)

SOT427

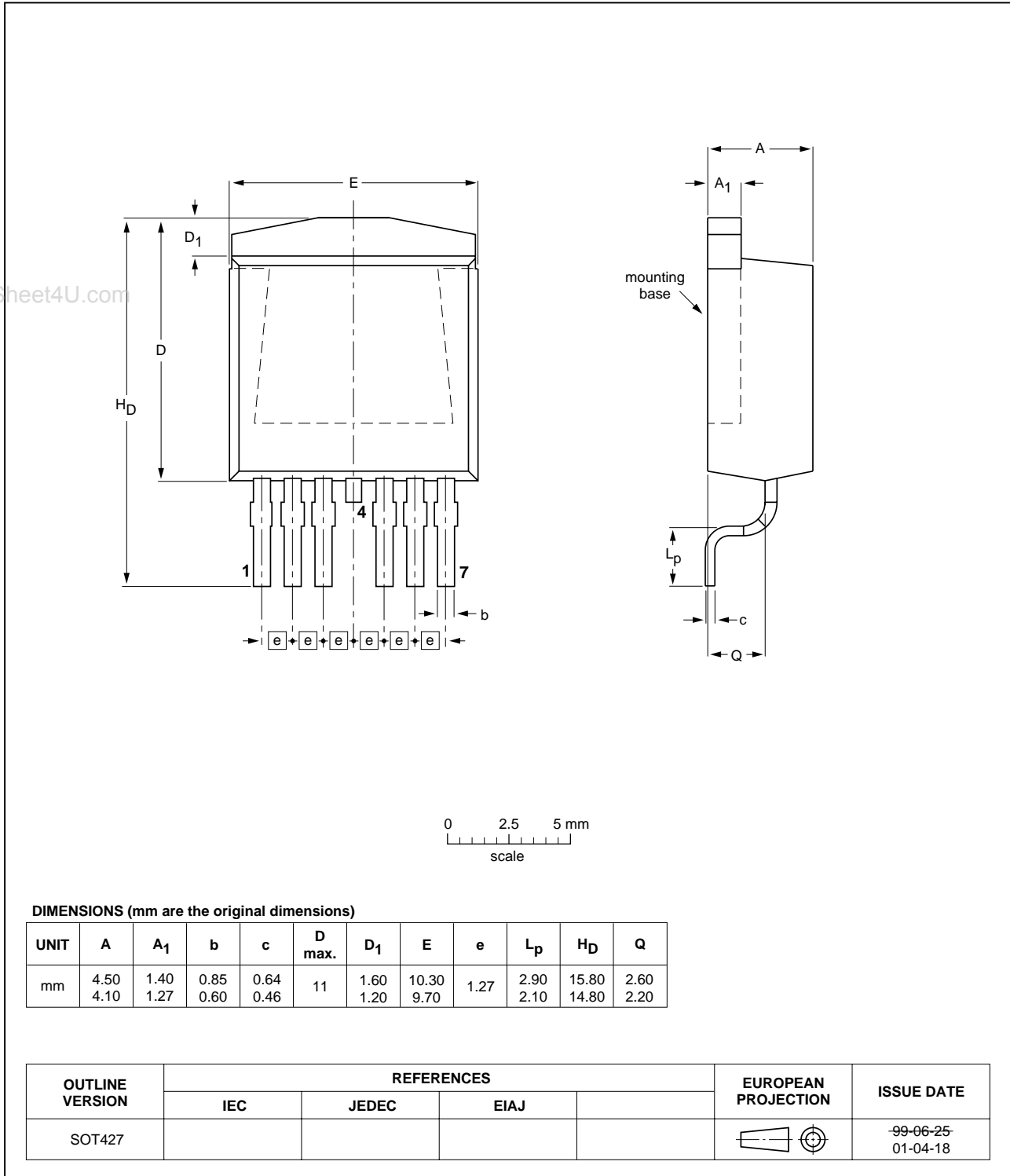
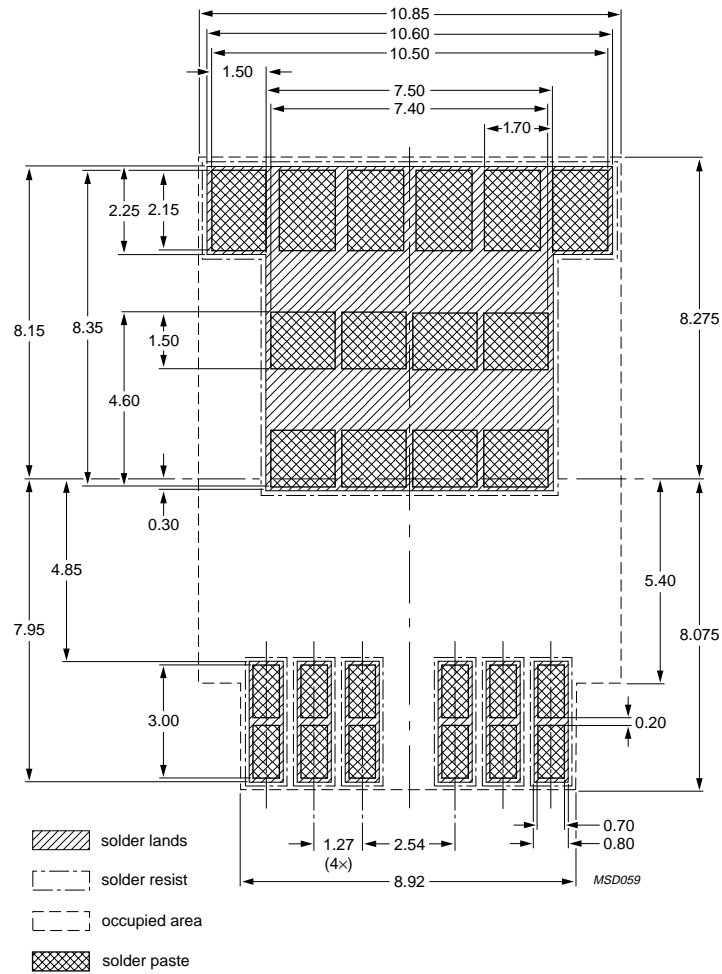


Fig 20. SOT427 (D²-PAK).

7. Soldering



Dimensions in mm.

Fig 21. Reflow soldering footprint for SOT427.

8. Revision history

Table 5: Revision history

Rev	Date	CPCN	Description
01	20030819	-	Product data; initial version (9397 750 11696)

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

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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.

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