

PHU78NQ03LT

N-channel TrenchMOS logic level FET

Rev. 06 — 15 June 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. This product is designed and qualified for use in computing, communications, consumer and industrial applications only.

1.2 Features and benefits

- Suitable for high frequency applications due to fast switching characteristics
- Suitable for logic level gate drive sources

1.3 Applications

- Computer motherboards
- DC-to-DC convertors

1.4 Quick reference data

Table 1. Quick reference

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ }^{\circ}\text{C}$; $T_j \leq 175\text{ }^{\circ}\text{C}$	-	-	25	V
I_D	drain current	$T_{mb} = 25\text{ }^{\circ}\text{C}$; $V_{GS} = 10\text{ V}$; see Figure 1 ; see Figure 3	-	-	75	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ }^{\circ}\text{C}$; see Figure 2	-	-	107	W
Dynamic characteristics						
Q_{GD}	gate-drain charge	$V_{GS} = 4.5\text{ V}$; $I_D = 25\text{ A}$; $V_{DS} = 12\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$; see Figure 9 ; see Figure 10	-	4	-	nC
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ }^{\circ}\text{C}$; see Figure 7 ; see Figure 8	-	7.65	9	m Ω

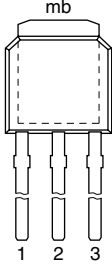
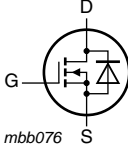
2. Ordering information

Table 2. Ordering information

Type number	Package		Version
	Name	Description	
PHU78NQ03LT	IPAK	plastic single-ended package (IPAK); 3 leads (in-line)	SOT533

3. Pinning information

Table 3. Pinning information

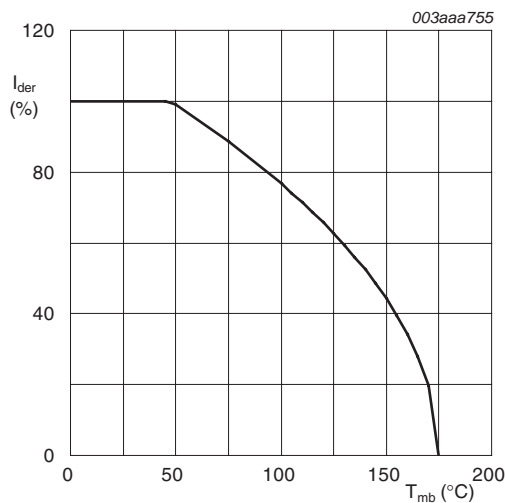
Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		
			SOT533 (IPAK)	

4. Limiting values

Table 4. Limiting values

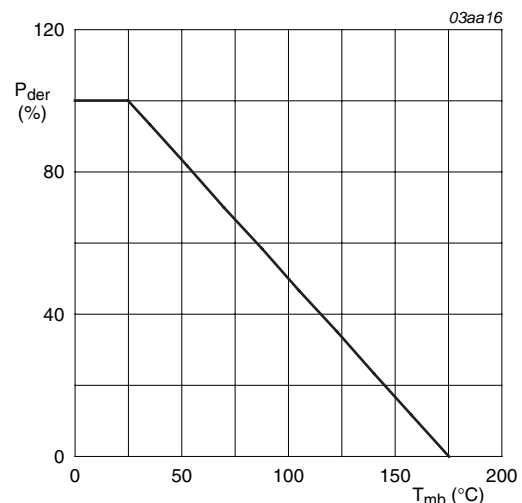
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{DS}	drain-source voltage	T _j ≥ 25 °C; T _j ≤ 175 °C	-	25	V
V _{DGR}	drain-gate voltage	R _{GS} = 20 kΩ; T _{mb} ≥ 25 °C; T _{mb} ≤ 175 °C	-	25	V
V _{GS}	gate-source voltage		-20	20	V
I _D	drain current	V _{GS} = 5 V; T _{mb} = 100 °C	-	46.9	A
		V _{GS} = 10 V; T _{mb} = 100 °C; see Figure 1	-	57.5	A
		V _{GS} = 10 V; T _{mb} = 25 °C; see Figure 1 ; see Figure 3	-	75	A
		V _{GS} = 5 V; T _{mb} = 25 °C	-	66.4	A
I _{DM}	peak drain current	t _p ≤ 10 μs; pulsed; T _{mb} = 25 °C; see Figure 3	-	240	A
P _{tot}	total power dissipation	T _{mb} = 25 °C; see Figure 2	-	107	W
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	-	75	A
I _{SM}	peak source current	t _p ≤ 10 μs; pulsed; T _{mb} = 25 °C	-	240	A
Avalanche ruggedness					
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	V _{GS} = 10 V; T _{j(init)} = 25 °C; I _D = 32 A; V _{sup} ≤ 25 V; unclamped; t _p = 0.17 ms; R _{GS} = 50 Ω	-	100	mJ



$$I_{der} = \frac{I_D}{I_{D(25^\circ\text{C})}} \times 100\%$$

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



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

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

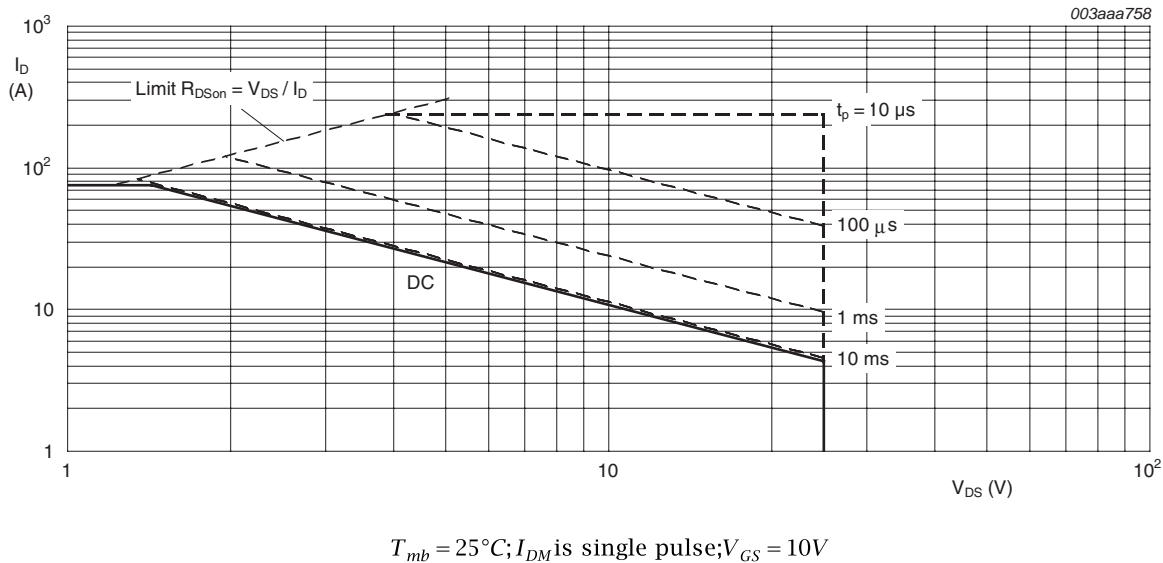


Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see Figure 4	-	-	1.4	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in free air	-	70	-	K/W

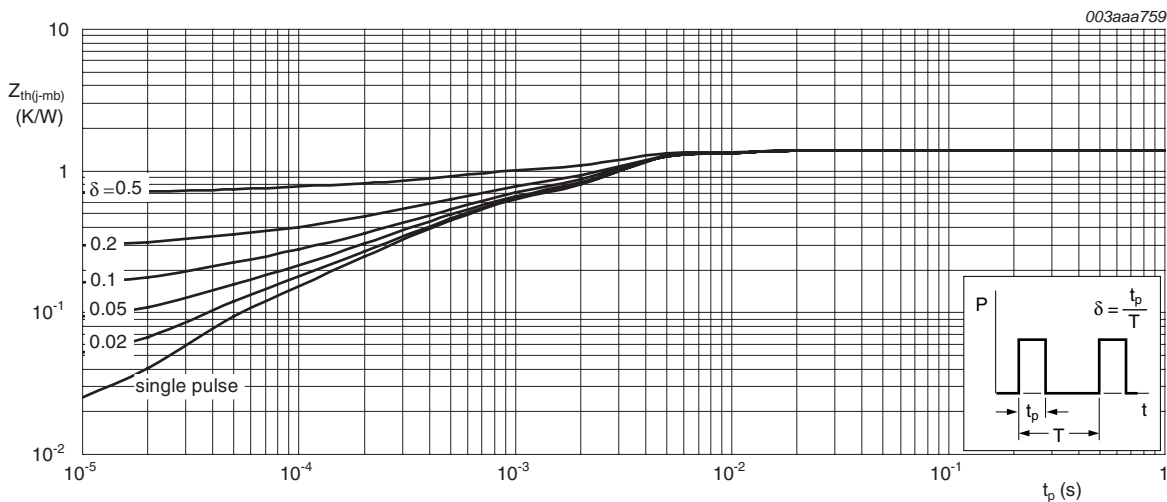


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\ \mu A$; $V_{GS} = 0\ V$; $T_j = -55\ ^\circ C$	22	-	-	V
		$I_D = 250\ \mu A$; $V_{GS} = 0\ V$; $T_j = 25\ ^\circ C$	25	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = -55\ ^\circ C$; see Figure 5 ; see Figure 6	-	-	2.2	V
		$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = 175\ ^\circ C$; see Figure 5 ; see Figure 6	0.5	-	-	V
		$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = 25\ ^\circ C$; see Figure 5 ; see Figure 6	1	1.5	2	V
I_{DSS}	drain leakage current	$V_{DS} = 25\ V$; $V_{GS} = 0\ V$; $T_j = 25\ ^\circ C$	-	-	1	μA
		$V_{DS} = 25\ V$; $V_{GS} = 0\ V$; $T_j = 175\ ^\circ C$	-	-	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 15\ V$; $V_{DS} = 0\ V$; $T_j = 25\ ^\circ C$	-	10	100	nA
		$V_{GS} = -15\ V$; $V_{DS} = 0\ V$; $T_j = 25\ ^\circ C$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\ V$; $I_D = 25\ A$; $T_j = 25\ ^\circ C$; see Figure 7 ; see Figure 8	-	7.65	9	m Ω
		$V_{GS} = 5\ V$; $I_D = 25\ A$; $T_j = 175\ ^\circ C$; see Figure 7 ; see Figure 8	-	18.9	24.3	m Ω
		$V_{GS} = 5\ V$; $I_D = 25\ A$; $T_j = 25\ ^\circ C$; see Figure 7 ; see Figure 8	-	10.5	13.5	m Ω
R_G	internal gate resistance (AC)	$f = 1\ MHz$; $T_j = 25\ ^\circ C$	-	1	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 0\ A$; $V_{DS} = 0\ V$; $V_{GS} = 4.5\ V$; $T_j = 25\ ^\circ C$	-	8.6	-	nC
		$I_D = 25\ A$; $V_{DS} = 12\ V$; $V_{GS} = 4.5\ V$; $T_j = 25\ ^\circ C$; see Figure 9 ; see Figure 10	-	11	-	nC
Q_{GS}	gate-source charge	$I_D = 25\ A$; $V_{DS} = 12\ V$; $V_{GS} = 4.5\ V$; $T_j = 25\ ^\circ C$; see Figure 10 ; see Figure 10	-	3.6	-	nC
Q_{GS1}	pre-threshold gate-source charge		-	1.8	-	nC
Q_{GS2}	post-threshold gate-source charge		-	1.8	-	nC
Q_{GD}	gate-drain charge		-	4	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25\ A$; $V_{DS} = 12\ V$; $T_j = 25\ ^\circ C$; see Figure 9 ; see Figure 10	-	3	-	V
C_{iss}	input capacitance	$V_{DS} = 12\ V$; $V_{GS} = 0\ V$; $f = 1\ MHz$; $T_j = 25\ ^\circ C$; see Figure 11	-	970	-	pF
			-	1460	-	pF
C_{oss}	output capacitance		-	415	-	pF
C_{rss}	reverse transfer capacitance		-	170	-	pF

Table 6. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t _{d(on)}	turn-on delay time	V _{DS} = 12 V; R _L = 0.5 Ω; V _{GS} = 5 V; R _{G(ext)} = 5.6 Ω; T _j = 25 °C	-	13	-	ns
t _r	rise time		-	46	-	ns
t _{d(off)}	turn-off delay time		-	20	-	ns
t _f	fall time		-	15	-	ns
Source-drain diode						
V _{SD}	source-drain voltage	I _S = 25 A; V _{GS} = 0 V; T _j = 25 °C; see Figure 12	-	0.78	1.2	V
t _{rr}	reverse recovery time	I _S = 20 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V;	-	35	-	ns
Q _r	recovered charge	V _{DS} = 25 V; T _j = 25 °C	-	20	-	nC

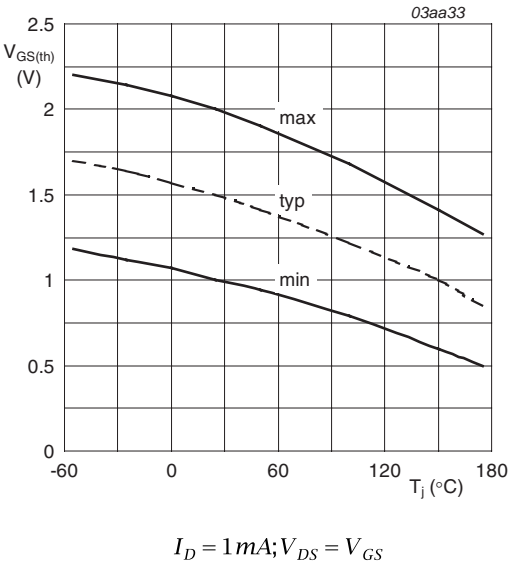


Fig 5. Gate-source threshold voltage as a function of junction temperature

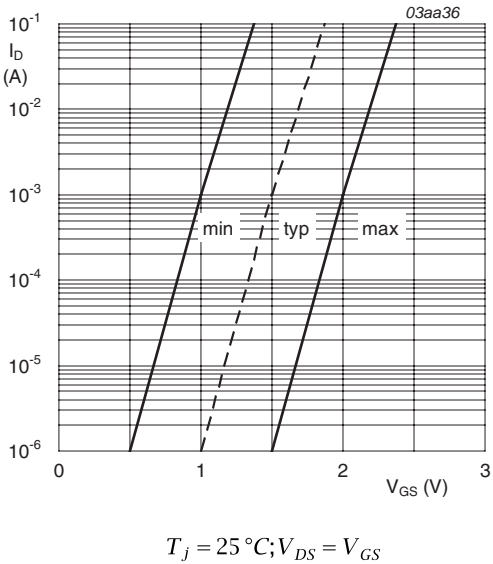


Fig 6. Sub-threshold drain current as a function of gate-source voltage

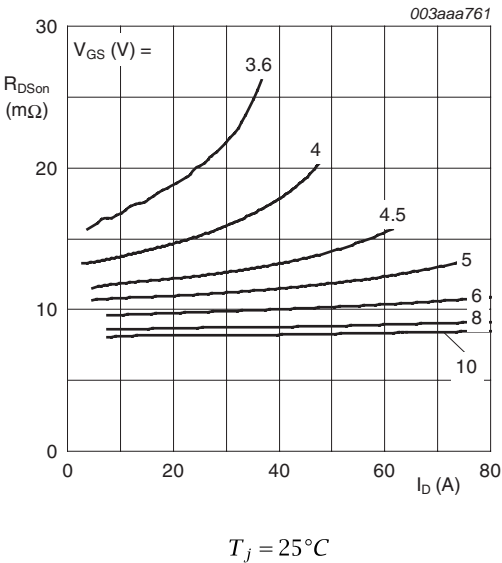
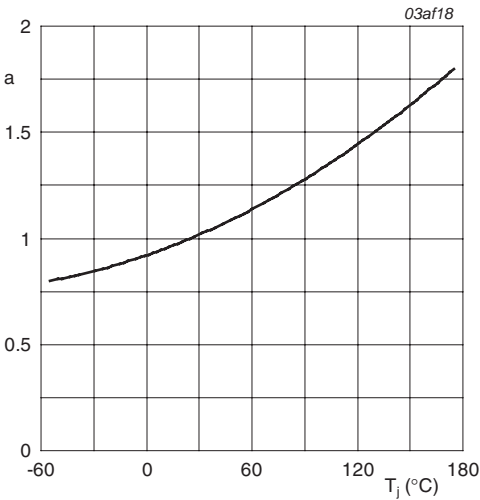


Fig 7. Drain-source on-state resistance as a function of drain current; typical values



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

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

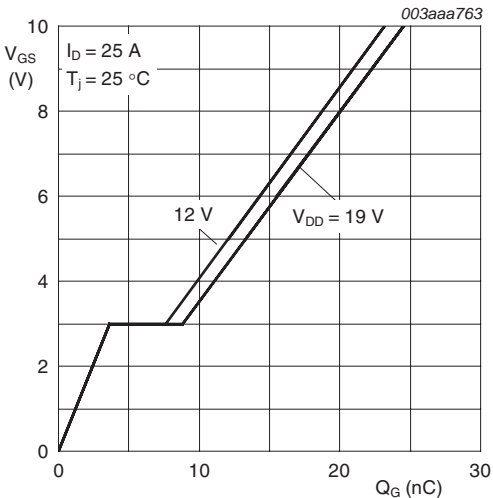


Fig 9. Gate-source voltage as a function of gate charge; typical values

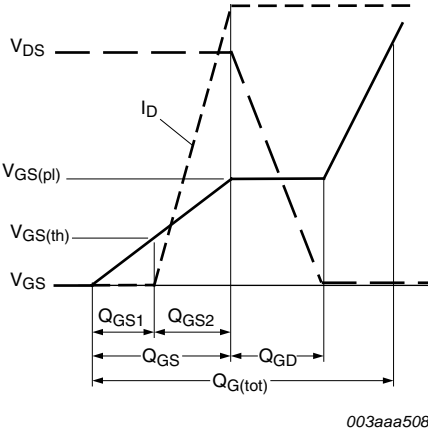
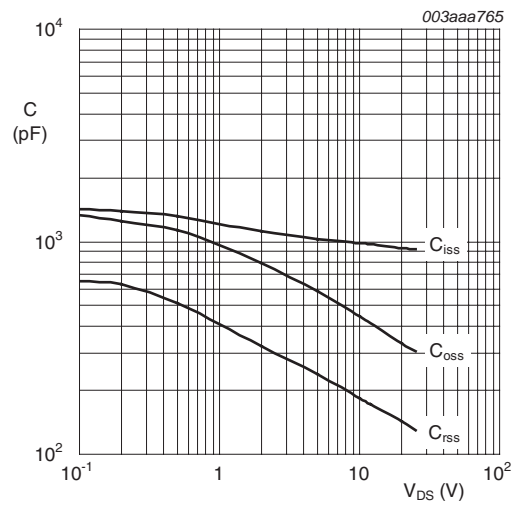
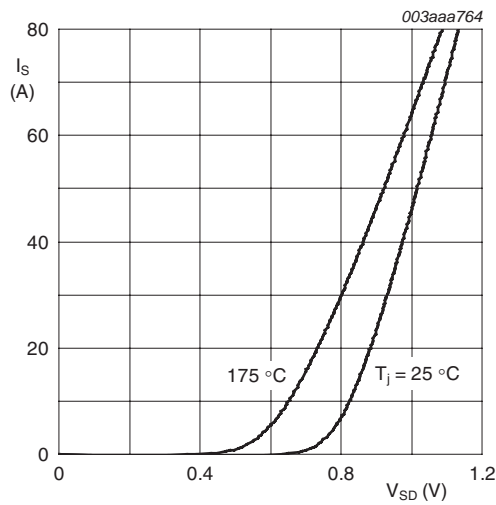


Fig 10. Gate charge waveform definitions



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

Fig 11. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$T_j = 25^{\circ}C \text{ and } 175^{\circ}C; V_{GS} = 0V$

Fig 12. Source current as a function of source-drain voltage; typical values

7. Package outline

Plastic single-ended package (IPAK); 3 leads (in-line)

SOT533

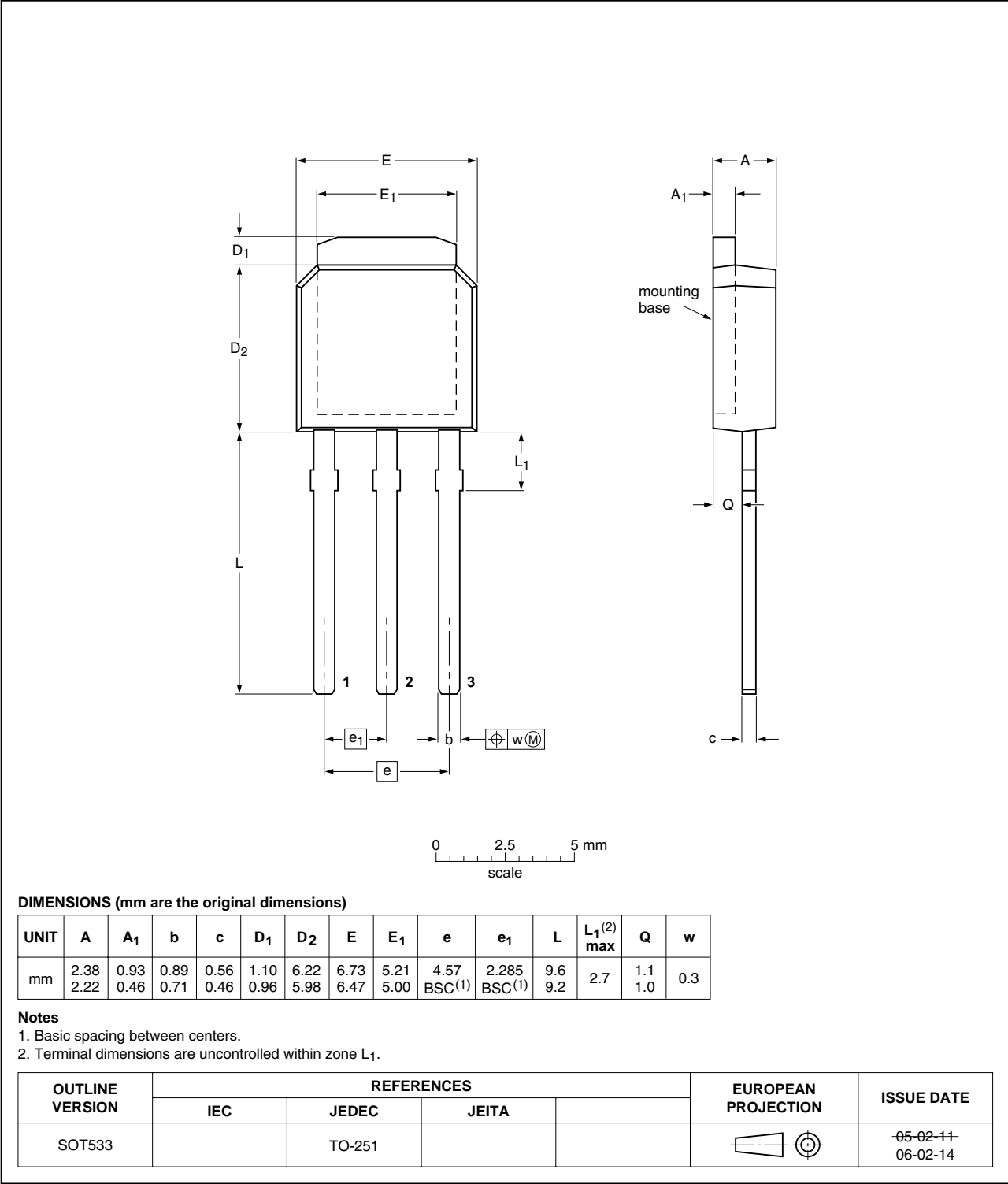


Fig 13. Package outline SOT533 (IPAK)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHU78NQ03LT_6	20090615	Product data sheet	-	PHU_PHD78NQ03LT_5
Modifications:	<ul style="list-style-type: none">• 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 PHU78NQ03LT separated from data sheet PHU_PHD78NQ03LT_5.			
PHU_PHD78NQ03LT_5 (9397 750 15084)	20050727	Product data sheet	-	PHP_PHU78NQ03LT_4
PHP_PHU78NQ03LT_4 (9397 750 13431)	20040726	Product data sheet	-	PHP_PHB_PHD78NQ03 LT-03
PHP_PHB_PHD78NQ03 LT-03 (9397 750 09667)	20020626	Product data	-	PHP_PHB_PHD78NQ03 LT-02
PHP_PHB_PHD78NQ03 LT-02 (9397 750 09418)	20020322	Product data	-	PHP_PHB_PHD78NQ03 LT-01
PHP_PHB_PHD78NQ03 LT-01 (9397 750 08916)	20011114	Product data	-	-

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.
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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".

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