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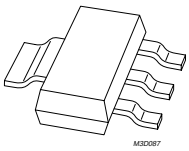


PHT4NQ10T

TrenchMOS™ standard level FET

Rev. 02 — 2 May 2002 **Product data**

1. Description

N-channel enhancement mode field-effect transistor in a plastic package using TrenchMOS™ technology.

Product availability:

PHT4NQ10T in SOT223.

2. Features

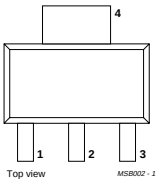
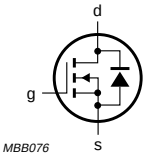
- TrenchMOS™ technology
- Very fast switching
- Surface mount package.

3. Applications

- Primary side switch in DC to DC converters
- High speed line driver
- Fast general purpose switch.

4. Pinning information

Table 1: Pinning - SOT223, simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	drain (d)		
3	source (g)		
4	drain (d)		

SOT223

5. Quick reference data

Table 2: Quick reference data

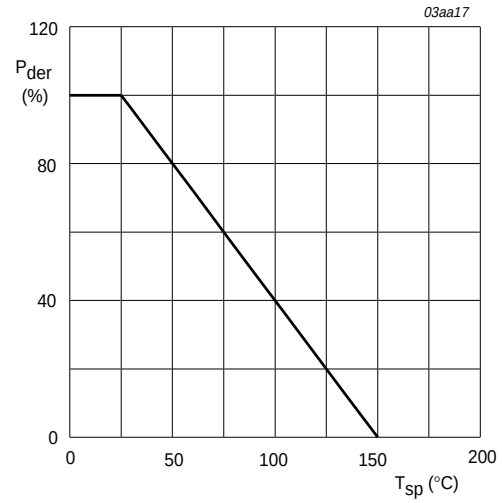
Symbol	Parameter	Conditions	Typ	Max	Unit
V_{DS}	drain-source voltage (DC)	25 °C ≤ T_j ≤ 150 °C	-	100	V
I_D	drain current (DC)	T_{sp} = 25 °C; V_{GS} = 10 V	-	3.5	A
P_{tot}	total power dissipation	T_{sp} = 25 °C	-	6.9	W
T_j	junction temperature		-	150	°C
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 1.75 A			
		T_j = 25 °C	200	250	mΩ
		T_j = 150 °C	-	575	mΩ

6. Limiting values

Table 3: Limiting values

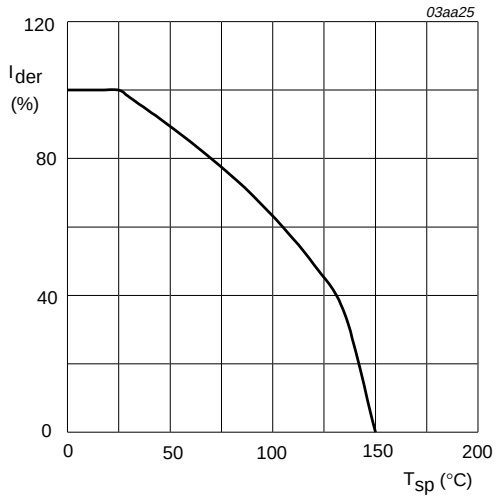
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	25 °C ≤ T_j ≤ 150 °C	-	100	V
V_{DGR}	drain-gate voltage (DC)	25 °C ≤ T_j ≤ 150 °C; R_{GS} = 20 kΩ	-	100	V
V_{GS}	gate-source voltage (DC)		-	±20	V
I_D	drain current (DC)	T_{sp} = 25 °C; V_{GS} = 10 V; Figure 2 and 3	-	3.5	A
		T_{sp} = 100 °C; V_{GS} = 10 V; Figure 2	-	2.2	A
I_{DM}	peak drain current	T_{sp} = 25 °C; pulsed; t_p ≤ 10 µs; Figure 3	-	14	A
P_{tot}	total power dissipation	T_{sp} = 25 °C; Figure 1	-	6.9	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–65	+150	°C
Source-drain diode					
I_S	source (diode forward) current (DC)	T_{sp} = 25 °C	-	3.5	A
I_{SM}	peak source (diode forward) current	T_{sp} = 25 °C; pulsed; t_p ≤ 10 µs	-	14	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; I_D = 3.5 A; t_p = 0.2 ms; V_{DD} ≤ 15 V; R_{GS} = 50 Ω; V_{GS} = 10 V; starting T_j = 25 °C; Figure 4	-	45	mJ
$I_{DS(AL)SM}$	peak non-repetitive drain-source avalanche current		-	3.5	A



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

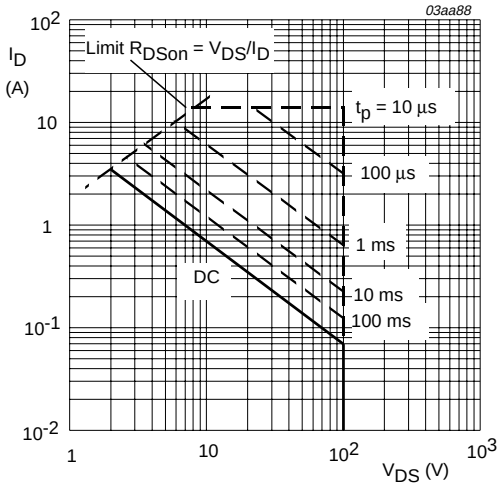
Fig 1. Normalized total power dissipation as a function of solder point temperature.



$V_{GS} \geq 10$ V

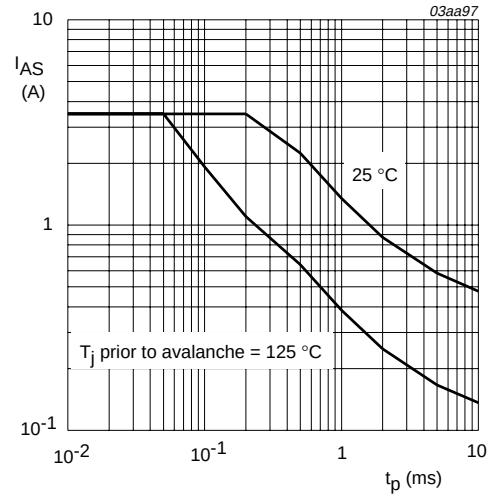
$$I_{der} = \frac{I_D}{I_{D(25^{\circ}C)}} \times 100\%$$

Fig 2. Normalized continuous drain current as a function of solder point temperature.



T_{sp} = 25 °C; I_{DM} is single pulse.

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



Unclamped inductive load; $V_{DD} \leq 15$ V; $R_{GS} = 50\ \Omega$; $V_{GS} = 10$ V; starting T_j = 25 °C and 125 °C.

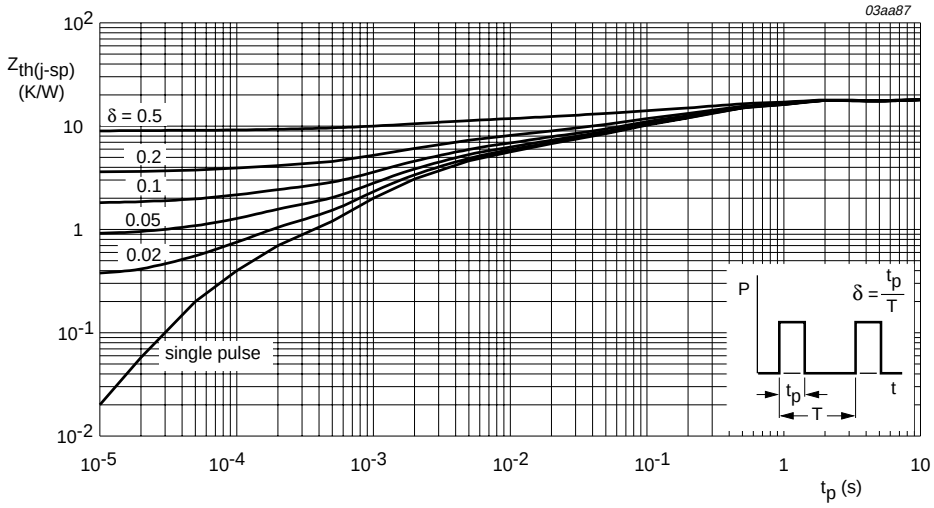
Fig 4. Non-repetitive avalanche ruggedness current as a function of pulse duration.

7. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	mounted on a metal clad substrate; Figure 5	-	-	18	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	mounted on a printed circuit board; minimum footprint	-	150	-	K/W

7.1 Transient thermal impedance



Mounted on a metal clad substrate.

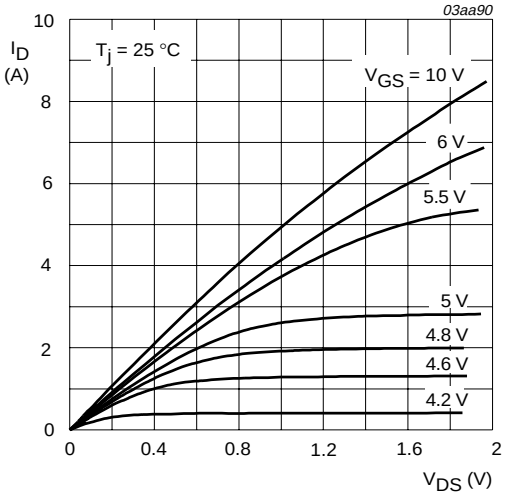
Fig 5. Transient thermal impedance from junction to solder point as a function of pulse duration.

8. Characteristics

Table 5: Characteristics

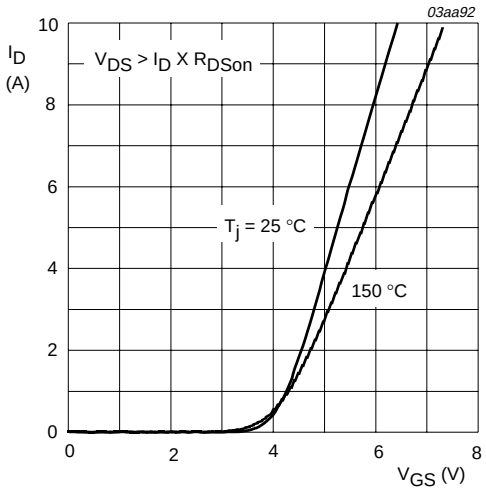
T_j = 25 °C unless otherwise specified

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	100	130	-	V
		T_j = –55 °C	89	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}				
		T_j = 25 °C; Figure 10	2	3	4	V
		T_j = 150 °C; Figure 10	1.2	-	-	V
		T_j = –55 °C; Figure 10	-	-	6	V
I_{DSS}	drain-source leakage current	V_{DS} = 100 V; V_{GS} = 0 V				
		T_j = 25 °C	-	1	25	µA
		T_j = 150 °C	-	4	250	µA
		V_{DS} = 60 V; V_{GS} = 0 V				
		T_j = 85 °C	-	-	1	µA
I_{GSS}	gate-source leakage current	V_{GS} = ±20 V; V_{DS} = 0 V	-	10	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 1.75 A				
		T_j = 25 °C; Figure 8 and 9	-	200	250	mΩ
		T_j = 150 °C; Figure 9	-	-	575	mΩ
Dynamic characteristics						
g_{fs}	forward transconductance	V_{DS} = 5 V; I_D = 3.5 A; Figure 12	-	4.2		S
$Q_{g(tot)}$	total gate charge	I_D = 3.5 A; V_{DS} = 80 V; V_{GS} = 10 V; Figure 15	-	7.4	-	nC
Q_{gs}	gate-source charge		-	1.5	-	nC
Q_{gd}	gate-drain (Miller) charge		-	3.3	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; Figure 13	-	300	-	pF
C_{oss}	output capacitance		-	44	-	pF
C_{rss}	reverse transfer capacitance		-	21	-	pF
$t_{d(on)}$	turn-on delay time	V_{DD} = 50 V; R_D = 15 Ω; V_{GS} = 10 V; R_G = 6 Ω	-	8	-	ns
t_r	rise time		-	13	-	ns
$t_{d(off)}$	turn-off delay time		-	20	-	ns
t_f	fall time		-	11	-	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	I_S = 3.5 A; V_{GS} = 0 V; Figure 14	-	0.87	1.5	V
t_{rr}	reverse recovery time	I_S = 3.5 A; dI_S/dt = –100 A/µs; V_{GS} = 0 V; V_{DS} = 30 V	-	50	-	ns
Q_r	recovered charge		-	100	-	nC



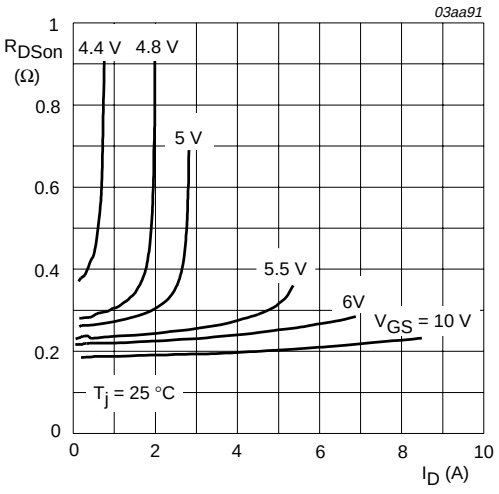
T_j = 25 °C

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



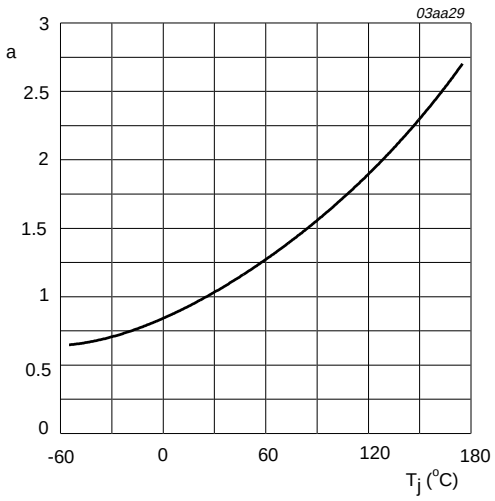
T_j = 25 °C and 150 °C; $V_{DS} > I_D \times R_{DSon}$

Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values.



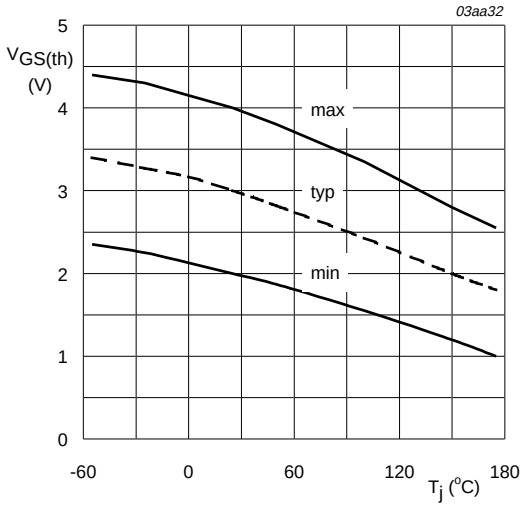
T_j = 25 °C

Fig 8. Drain-source on-state resistance as a function of drain current; typical values.



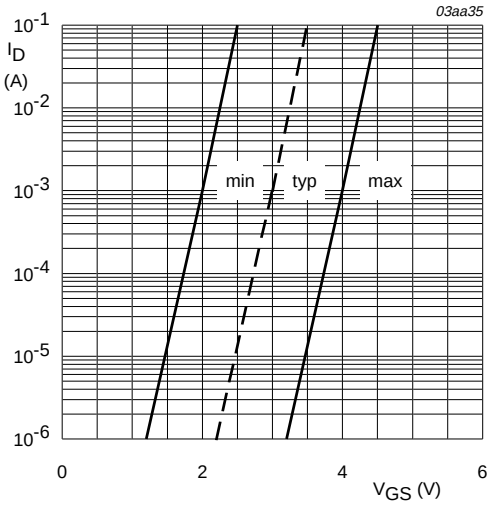
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

Fig 9. Normalized drain-source on-state resistance factor as a function of junction temperature.



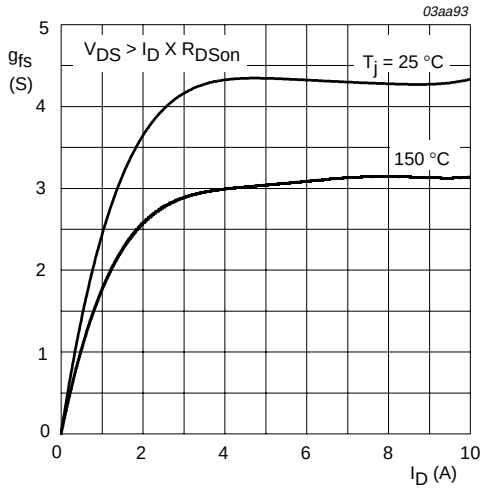
I_D = 1 mA; V_{DS} = V_{GS}

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



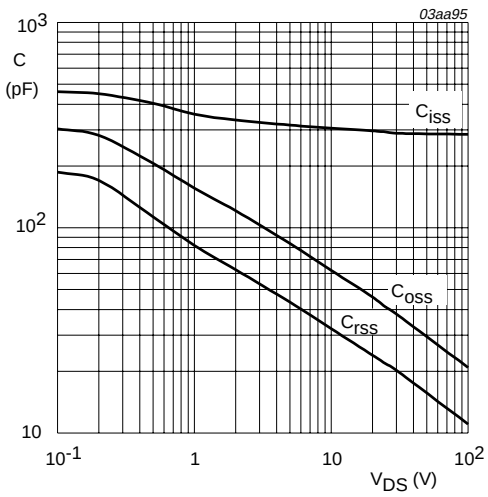
T_j = 25 °C; V_{DS} = 5 V

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



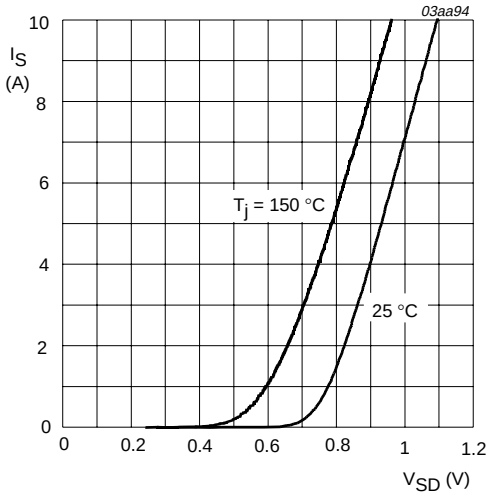
T_j = 25 °C and 150 °C; $V_{DS} > I_D \times R_{DSon}$

Fig 12. Forward transconductance as a function of drain current; typical values.



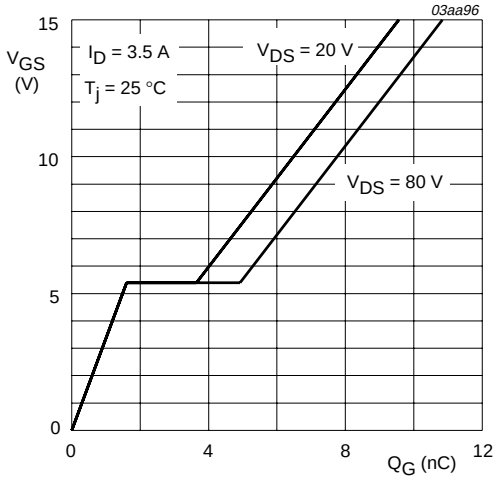
V_{GS} = 0 V; f = 1 MHz

Fig 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values.



T_j = 25 °C and 150 °C; V_{GS} = 0 V

Fig 14. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values.

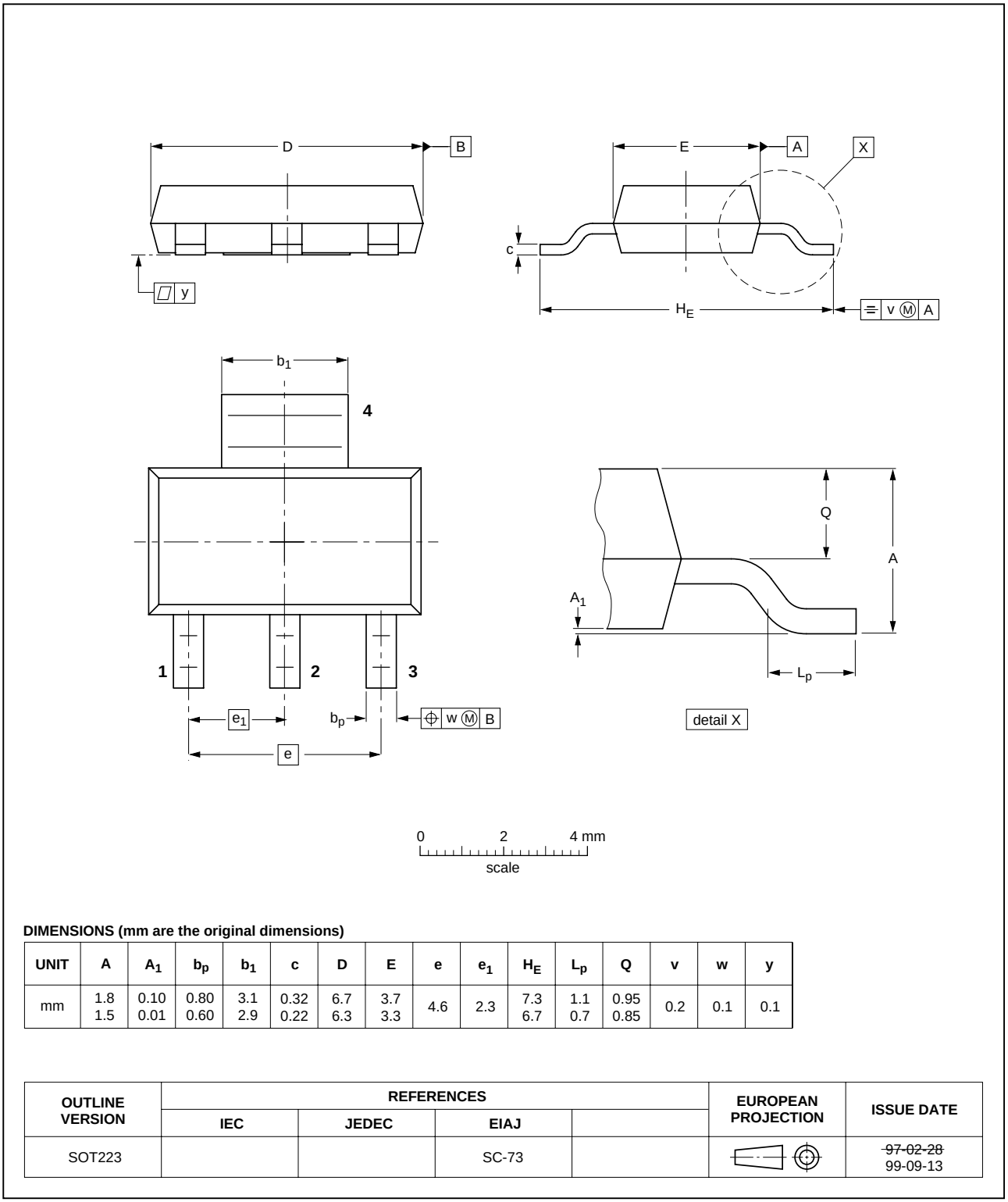


I_D = 3.5 A; V_{DS} = 80 V

Fig 15. Gate-source voltage as a function of gate charge; typical values.

9. Package outline

Plastic surface mounted package; collector pad for good heat transfer; 4 leads **SOT223**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.8 1.5	0.10 0.01	0.80 0.60	3.1 2.9	0.32 0.22	6.7 6.3	3.7 3.3	4.6	2.3	7.3 6.7	1.1 0.7	0.95 0.85	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT223			SC-73			~~97-02-28~~ 99-09-13

Fig 16. SOT223.

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
02	20020502	-	**Product data (9397 750 09581)** Modifications: • Additional I_{DSS} data added.
01	20000731	-	**Product specification; initial version.**

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9397 750 09581

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