

NX2301P

20 V, 2 A P-channel Trench MOSFET

Rev. 1 — 26 October 2010 Product data sheet

1. Product profile

1.1 General description

P-channel enhancement mode Field-Effect Transistor (FET) in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

1.2 Features and benefits

- 1.8 V R_{DSon} rated for Low Voltage Gate Drive
- Very fast switching
- Trench MOSFET technology
- AEC-Q101 qualified

1.3 Applications

- Relay driver
- High-speed line driver
- High-side loadswitch
- Switching circuits

1.4 Quick reference data

Table 1. Quick reference data

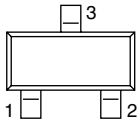
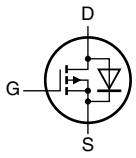
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	T_{amb} = 25 °C		-	-	−20	V
V_{GS}	gate-source voltage	T_{amb} = 25 °C		-	-	±8	V
I_D	drain current	T_{amb} = 25 °C; V_{GS} = −4.5 V	[1]	-	-	−2	A
R_{DSon}	drain-source on-state resistance	T_j = 25 °C; V_{GS} = −4.5 V; I_D = −1 A	[2]	-	100	120	mΩ

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm^2, $t \leq 5$ s.

[2] Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

2. Pinning information

Table 2. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	S	source		
3	D	drain		

017aaa094

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NX2301P	TO-236AB	plastic surface-mounted package; 3 leads	SOT23

4. Marking

Table 4. Marking codes

Type number	Marking code[1]
NX2301P	MG*

[1] * = placeholder for manufacturing site code

5. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	T_{amb} = 25 °C		-	−20	V
V_{GS}	gate-source voltage	T_{amb} = 25 °C		-	±8	V
I_D	drain current	V_{GS} = −4.5 V	[1]			
		T_{amb} = 25 °C		-	−2	A
		T_{amb} = 100 °C		-	−1.2	A
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq 10$ µs		-	−6	A

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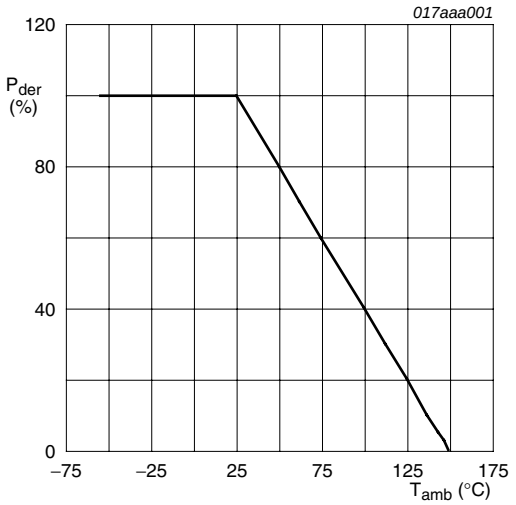
Table 5. Limiting values *...continued*

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

Symbol	Parameter	Conditions		Min	Max	Unit
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	400	mW
			[1]	-	710	mW
		T_{sp} = 25 °C		-	2.8	W
T_j	junction temperature				150	°C
T_{amb}	ambient temperature			–55	+150	°C
T_{stg}	storage temperature			–65	+150	°C
Source-drain diode						
I_S	source current	T_{amb} = 25 °C	[1]	-	–0.7	A

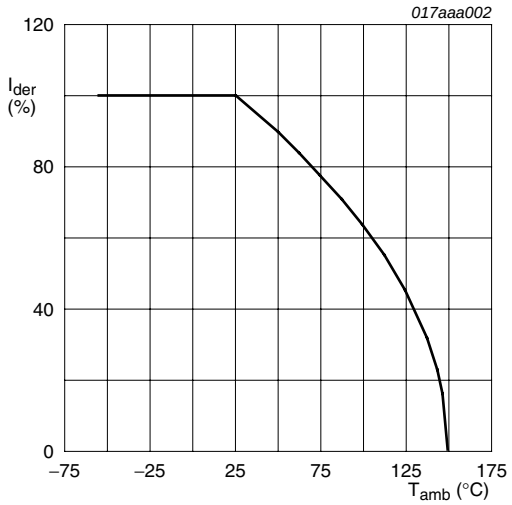
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm^2, t ≤ 5 s.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.



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

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

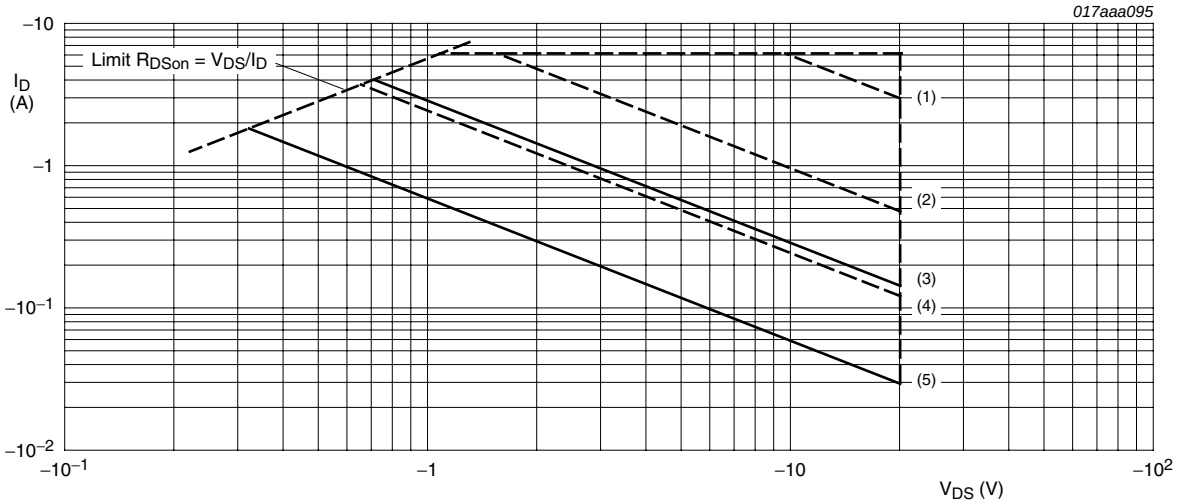


$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\ \%$$

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

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I_{DM} = single pulse

(1) t_p = 1 ms

(2) t_p = 10 ms

(3) DC; T_{sp} = 25 °C

(4) t_p = 100 ms

(5) DC; T_{amb} = 25 °C; drain mounting pad 6 cm^2

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

6. Thermal characteristics

Table 6. Thermal characteristics

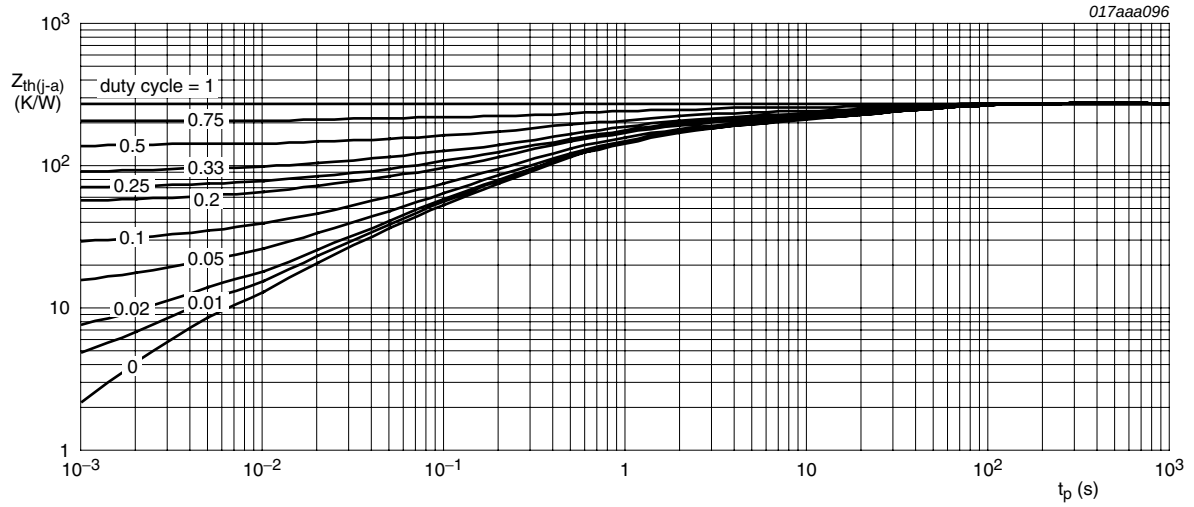
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	315	K/W
			[2]	-	-	175	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	45	K/W

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm^2, $t \leq 5$ s.

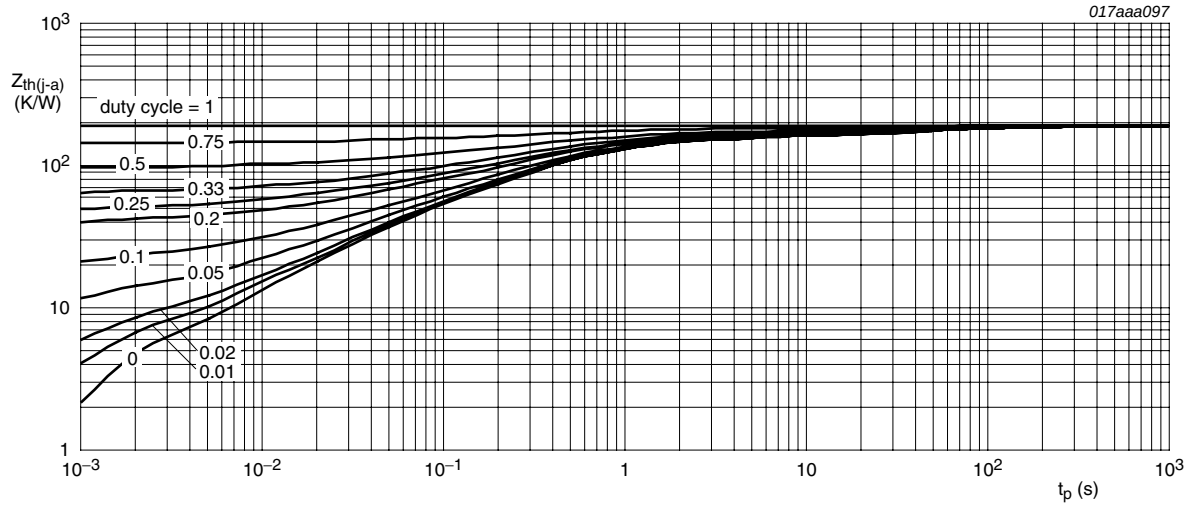
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FR4 PCB, standard footprint

Fig 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



FR4 PCB, mounting pad for drain 6 cm^2

Fig 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

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7. Characteristics

Table 7. Characteristics

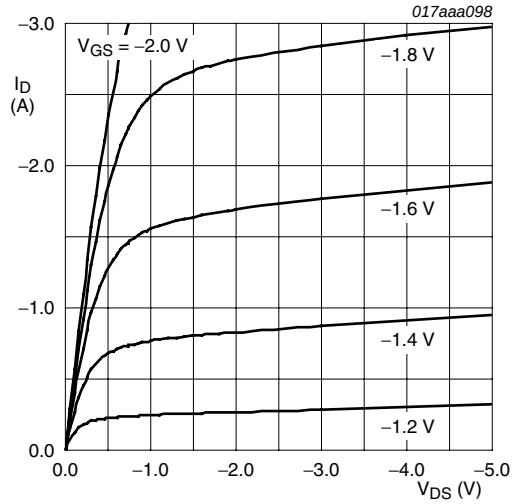
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = −250 μA; V_{GS} = 0 V		−20	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = −250 μA; V_{DS} = V_{GS}		−0.5	−0.75	−1.1	V
I_{DSS}	drain leakage current	V_{DS} = −20 V; V_{GS} = 0 V		-	-	−1	μA
I_{GSS}	gate leakage current	V_{GS} = ±8 V; V_{DS} = 0 V		-	-	±100	nA
R_{DSon}	drain-source on-state resistance		[1]				
		V_{GS} = −4.5 V; I_D = −1 A					
		T_j = 25 °C			100	120	mΩ
		T_j = 150 °C			-	180	mΩ
		V_{GS} = −2.5 V; I_D = −1 A		-	155	190	mΩ
		V_{GS} = −1.8 V; I_D = −0.2 A		-	210	270	mΩ
g_{fs}	forward transconductance	V_{DS} = −5 V; I_D = −2 A	[1]	-	4.7	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = −2.2 A; V_{DS} = −6 V; V_{GS} = −4.5 V		-	4.5	6	nC
Q_{GS}	gate-source charge			-	1.1	-	nC
Q_{GD}	gate-drain charge			-	0.9	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = −6 V; f = 1 MHz		-	380	-	pF
C_{oss}	output capacitance			-	135	-	pF
C_{rss}	reverse transfer capacitance			-	115	-	pF
$t_{d(on)}$	turn-on delay time	V_{DD} = −6 V; R_L = 6 Ω; V_{GS} = −4.5 V; R_G = 6 Ω		-	7	-	ns
t_r	rise time			-	15	-	ns
$t_{d(off)}$	turn-off delay time			-	50	-	ns
t_f	fall time			-	25	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = −1 A; V_{GS} = 0 V	[1]	-	−0.8	−1.0	V

[1] Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.01$.

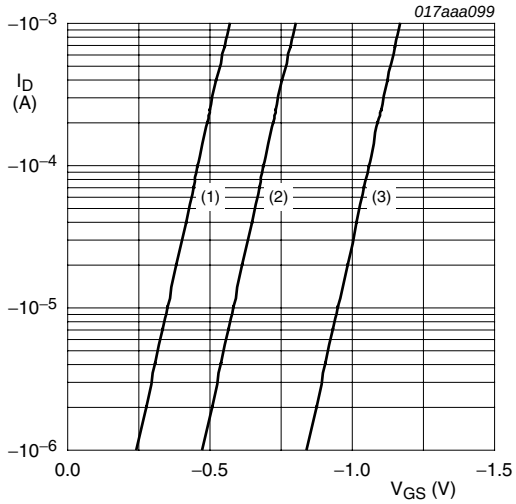
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T_{amb} = 25 °C

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



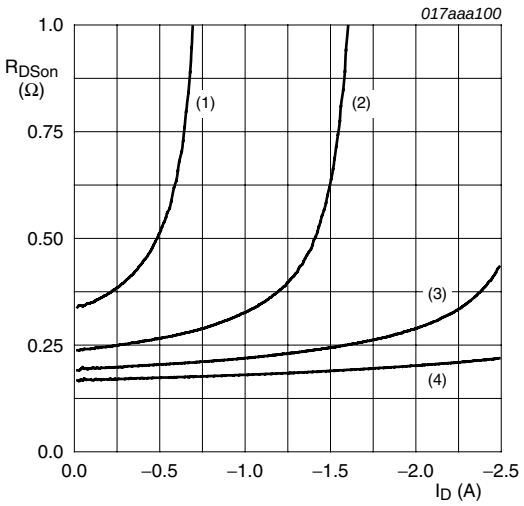
T_{amb} = 25 °C; V_{DS} = −10 V

(1) minimum values

(2) typical values

(3) maximum values

Fig 7. Sub-threshold drain current as a function of gate-source voltage



T_{amb} = 25 °C

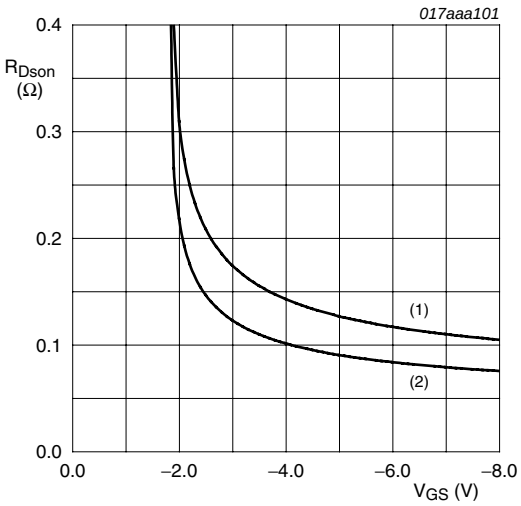
(1) V_{GS} = −1.4 V

(2) V_{GS} = −1.6 V

(3) V_{GS} = −1.8 V

(4) V_{GS} = −2.0 V

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



I_D = −2 A

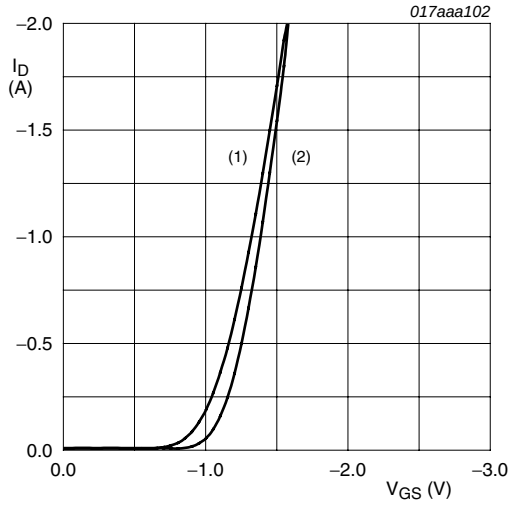
(1) T_{amb} = 125 °C

(2) T_{amb} = 25 °C

Fig 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

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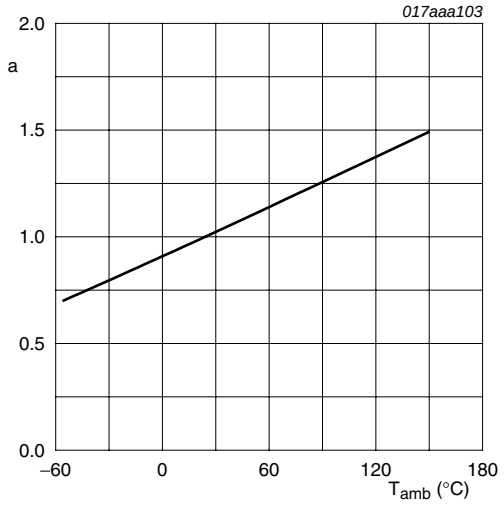


$V_{DS} > I_D \times R_{DSon}$

(1) T_{amb} = 150 °C

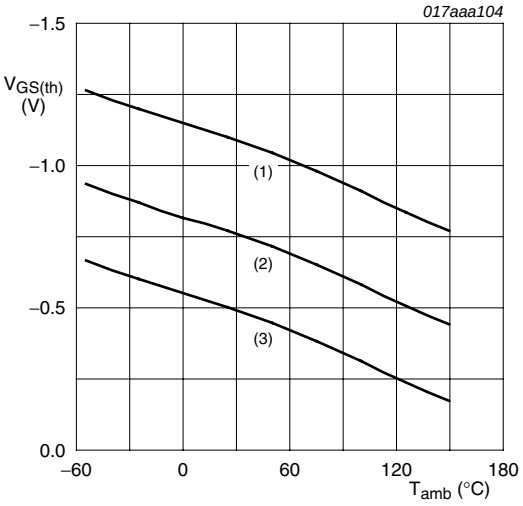
(2) T_{amb} = 25 °C

Fig 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values



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

Fig 11. Normalized drain-source on-state resistance as a function of ambient temperature; typical values



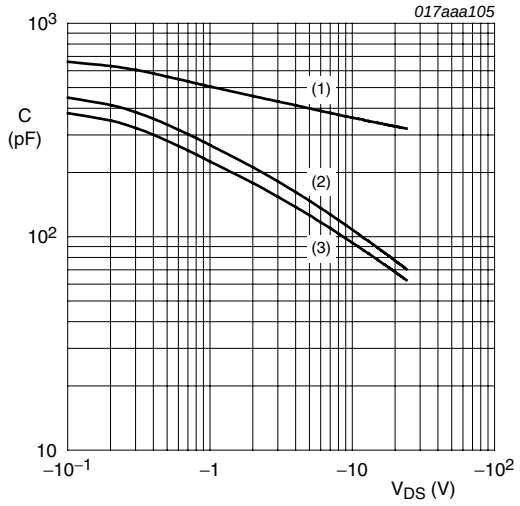
I_D = −0.25 mA; $V_{DS} = V_{GS}$

(1) maximum values

(2) typical values

(3) minimum values

Fig 12. Gate-source threshold voltage as a function of ambient temperature



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

(1) C_{iss}

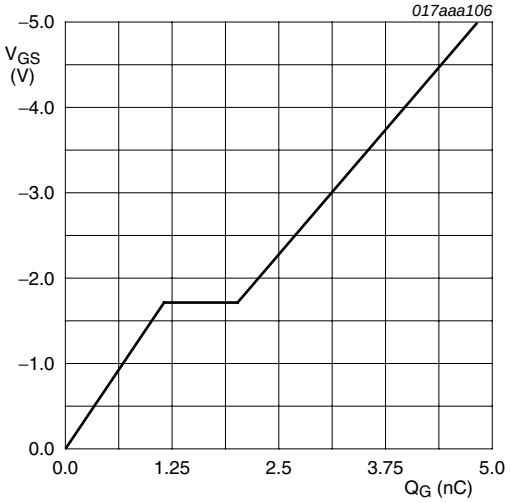
(2) C_{oss}

(3) C_{rss}

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

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I_D = −2 A; V_{DS} = −6 V; T_{amb} = 25 °C

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

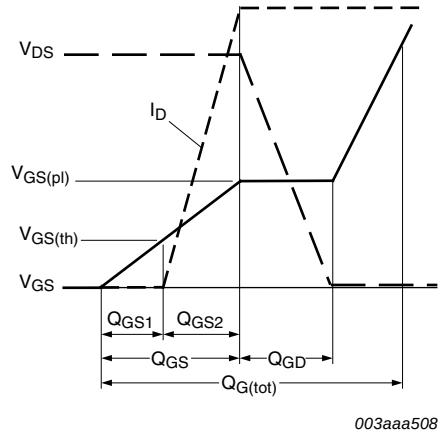
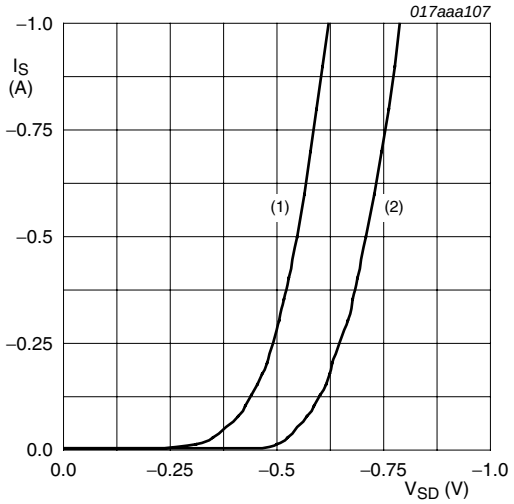


Fig 15. Gate charge waveform definitions



V_{GS} = 0 V

(1) T_{amb} = 150 °C

(2) T_{amb} = 25 °C

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

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8. Test information

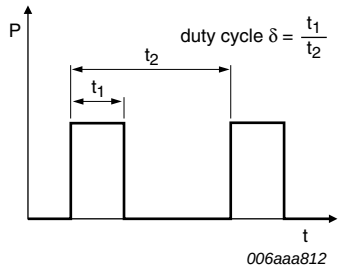


Fig 17. Duty cycle definition

8.1 Quality information

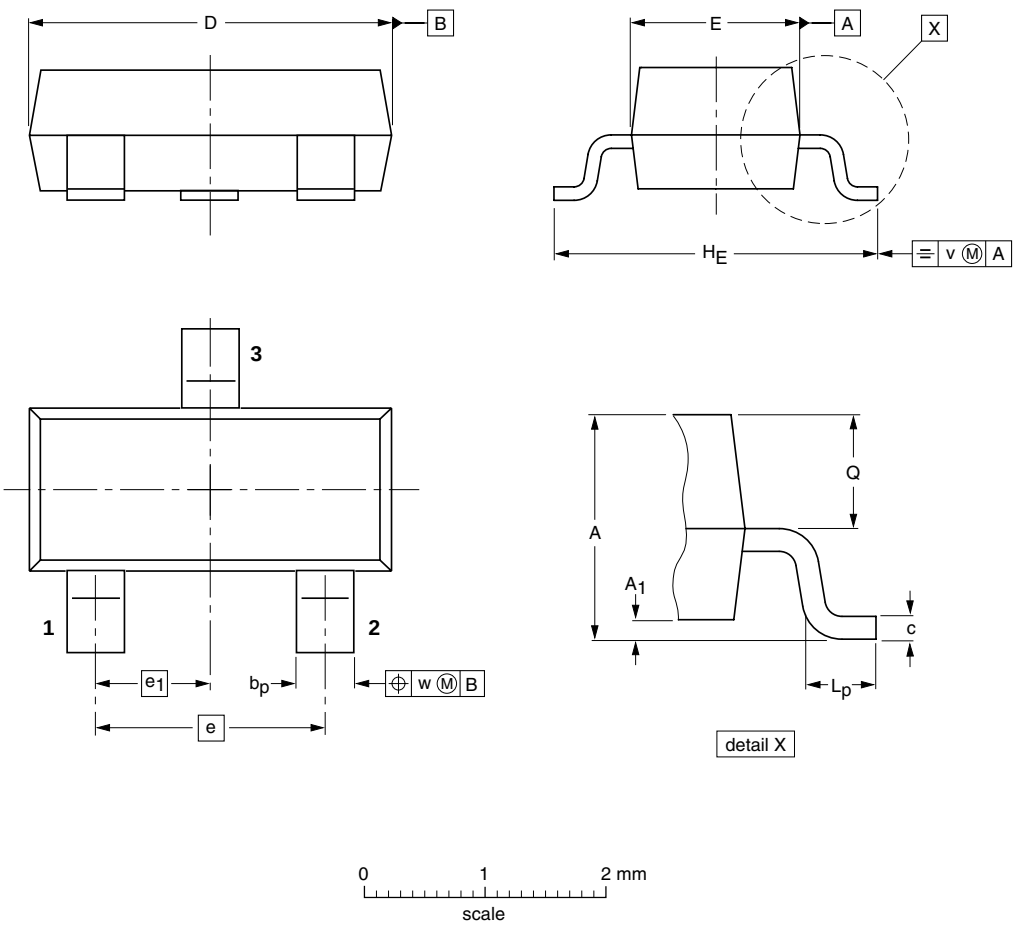
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9. Package outline

Plastic surface-mounted package; 3 leads **SOT23**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max.	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	1.1 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT23		TO-236AB				~~04-11-04~~ 06-03-16

Fig 18. Package outline SOT23 (TO-236AB)

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10. Soldering

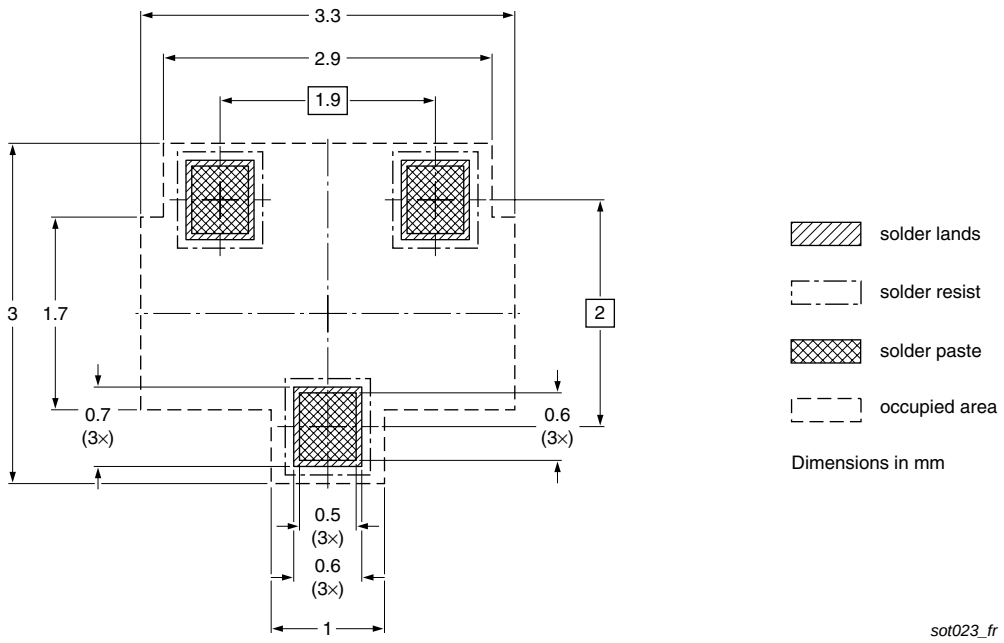


Fig 19. Reflow soldering footprint SOT23 (TO-236AB)

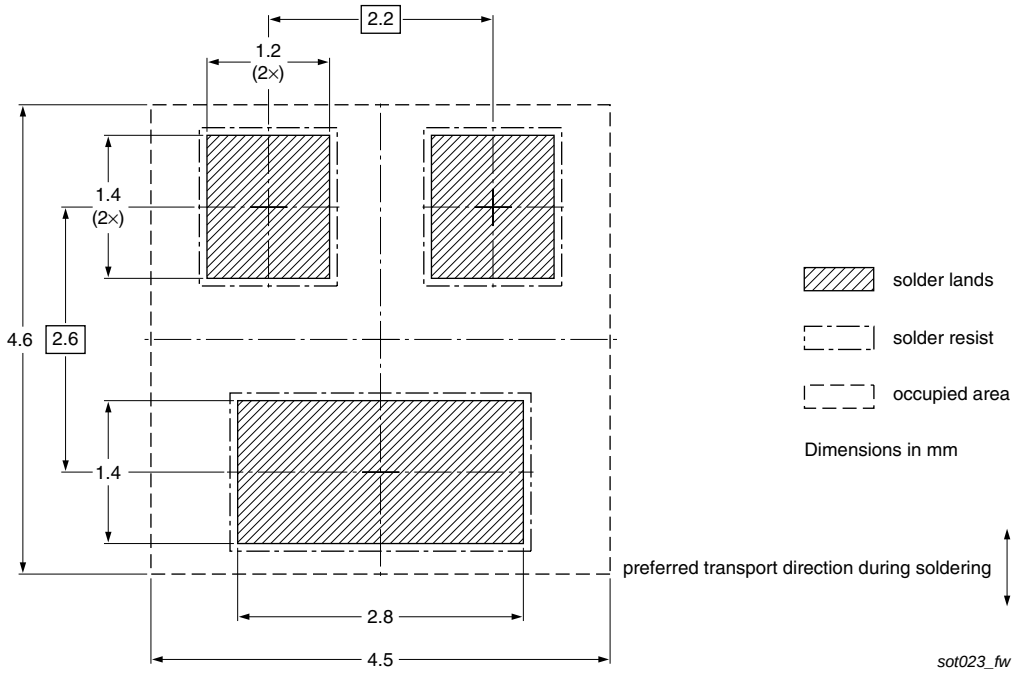


Fig 20. Wave soldering footprint SOT23 (TO-236AB)

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11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX2301P v.1	20101026	Product data sheet	-	-

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12. Legal information

12.1 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".

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