

NX2301P

20 V, 2 A P-channel Trench MOSFET Rev. 1 — 26 October 2010

Product data sheet

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	Тур	Max	Unit
V_{DS}	drain-source voltage	$T_{amb} = 25 ^{\circ}C$	-	-	-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	Α
R _{DSon}	drain-source on-state resistance	$T_j = 25 ^{\circ}\text{C};$ $V_{GS} = -4.5 \text{V};$ $I_D = -1 \text{A}$	<u>[2]</u> -	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: $t_p \le 300 \ \mu s; \ \delta \le 0.01.$

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2. Pinning information

Table 2. Pinning

I GIDIO E.	9			
Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	S	source		
3	D	drain	1 2	G S

3. Ordering information

Table 3. Ordering information

Type number	Package	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).

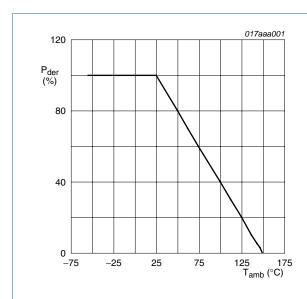
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	T _{amb} = 25 °C	-	-20	V
V_{GS}	gate-source voltage	T _{amb} = 25 °C	-	±8	V
I _D	drain current	$V_{GS} = -4.5 \text{ V}$	<u>[1]</u>		
		T _{amb} = 25 °C	-	-2	Α
		T _{amb} = 100 °C	-	-1.2	Α
I _{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \le 10 \mu s$	-	-6	Α

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Table 5. Limiting values ...continued
In accordance with the Absolute Maximum Rating System (IEC 60134).

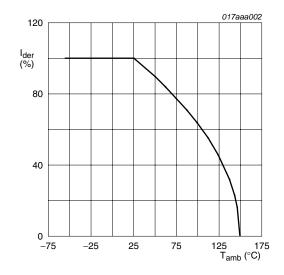
			<u> </u>		
Symbol	Parameter	Conditions	Min	Max	Unit
P _{tot} total p	total power dissipation	otal power dissipation T _{amb} = 25 °C	[2] -	400	mW
			[1] -	710	mW
		T _{sp} = 25 °C	-	2.8	W
Tj	junction temperature			150	°C
T _{amb}	ambient temperature		-55	+150	°C
T _{stg}	storage temperature		-65	+150	°C
Source-d	rain diode				
I _S	source current	T _{amb} = 25 °C	<u>[1]</u> -	-0.7	Α

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



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

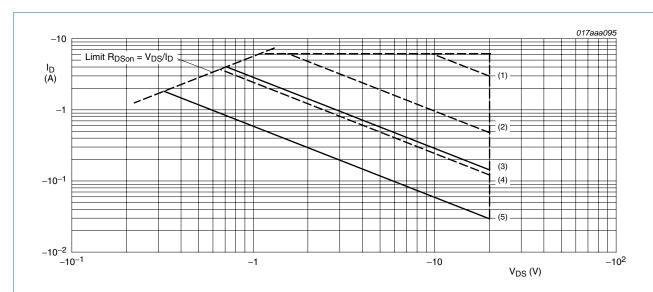
Fig 1. Normalized total power dissipation as a function of ambient temperature



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

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

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I_{DM} = single pulse

- (1) $t_p = 1 \text{ ms}$
- (2) $t_p = 10 \text{ ms}$
- (3) DC; $T_{sp} = 25 \, ^{\circ}C$
- (4) $t_p = 100 \text{ ms}$
- (5) DC; $T_{amb} = 25 \, ^{\circ}C$; drain mounting pad 6 cm²

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

6. Thermal characteristics

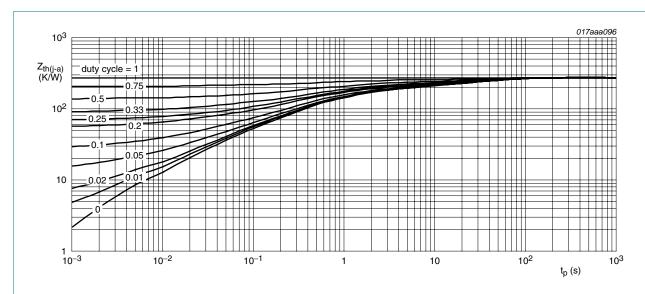
Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
R _{th(j-a)}	thermal resistance from	in free air	<u>[1]</u> -	-	315	K/W
	junction to ambient		[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.

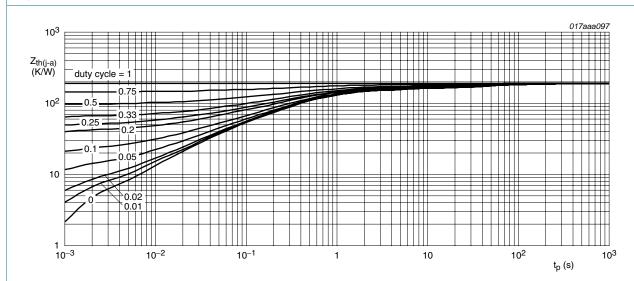
^[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 6 cm 2 , t \leq 5 s.

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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 cm²

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

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7. Characteristics

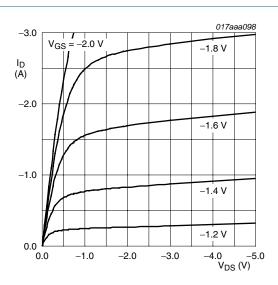
Table 7. Characteristics

 $T_i = 25$ °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
Static cha	racteristics					
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = -250 \mu A; V_{GS} = 0 V$	-20	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = -250 \ \mu A; \ V_{DS} = V_{GS}$	-0.5	-0.75	-1.1	V
I _{DSS}	drain leakage current	$V_{DS} = -20 \text{ V}; V_{GS} = 0 \text{ V}$	-	-	-1	μΑ
I _{GSS}	gate leakage current	$V_{GS} = \pm 8 \text{ V}; V_{DS} = 0 \text{ V}$	-	-	±100	nA
R _{DSon}	drain-source on-state		<u>[1]</u>			
	resistance	$V_{GS} = -4.5 \text{ V}; I_D = -1 \text{ A}$				
		T _j = 25 °C		100	120	$m\Omega$
		T _j = 150 °C		-	180	$m\Omega$
		$V_{GS} = -2.5 \text{ V}; I_D = -1 \text{ A}$	-	155	190	$m\Omega$
		$V_{GS} = -1.8 \text{ V};$ $I_D = -0.2 \text{ A}$	-	210	270	mΩ
g fs	forward transconductance	$V_{DS} = -5 \text{ V}; I_D = -2 \text{ A}$	<u>[1]</u> -	4.7	-	S
Dynamic o	characteristics					
Q _{G(tot)}	total gate charge	$I_D = -2.2 \text{ A}; V_{DS} = -6 \text{ V};$	-	4.5	6	nC
Q_{GS}	gate-source charge	$V_{GS} = -4.5 \text{ V}$	-	1.1	-	nC
Q_{GD}	gate-drain charge		-	0.9	-	nC
C _{iss}	input capacitance	$V_{GS} = 0 \text{ V}; V_{DS} = -6 \text{ V};$	-	380	-	pF
C _{oss}	output capacitance	f = 1 MHz	-	135	-	pF
C _{rss}	reverse transfer capacitance		-	115	-	pF
t _{d(on)}	turn-on delay time	$V_{DD} = -6 \text{ V};$	-	7	-	ns
t _r	rise time	$R_L = 6 \Omega;$ - $V_{GS} = -4.5 V;$	-	15	-	ns
t _{d(off)}	turn-off delay time	$R_{G} = 6 \Omega$	-	50	-	ns
t _f	fall time	-	-	25	-	ns
Source-dr	ain diode					
V_{SD}	source-drain voltage	$I_S = -1 A; V_{GS} = 0 V$	<u>[1]</u> _	-0.8	-1.0	V

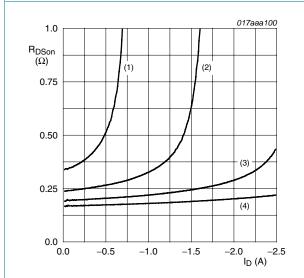
^[1] Pulse test: $t_p \le 300~\mu s;~\delta \le 0.01.$

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 $T_{amb} = 25 \, ^{\circ}C$

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



T_{amb} = 25 °C

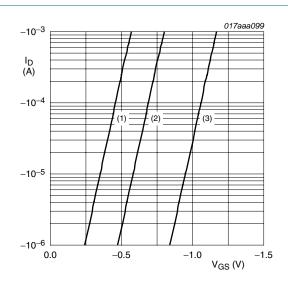
(1) $V_{GS} = -1.4 \text{ V}$

(2) $V_{GS} = -1.6 \text{ V}$

(3) $V_{GS} = -1.8 \text{ V}$

(4) $V_{GS} = -2.0 \text{ V}$

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



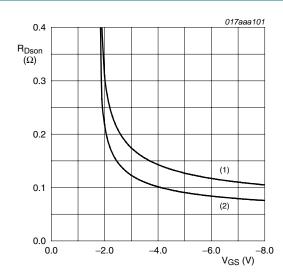
 $T_{amb} = 25 \, ^{\circ}C; \, V_{DS} = -10 \, V$

(1) minimum values

(2) typical values

(3) maximum values

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



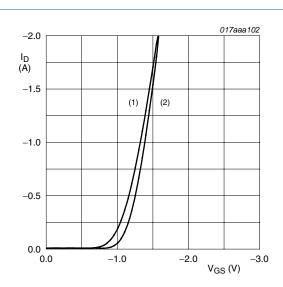
 $I_{D} = -2 A$

(1) $T_{amb} = 125 \, ^{\circ}C$

(2) $T_{amb} = 25 \, ^{\circ}C$

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

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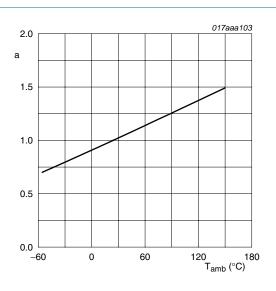


$$V_{DS} > I_D \times R_{DSon}$$

(1)
$$T_{amb} = 150 \, ^{\circ}C$$

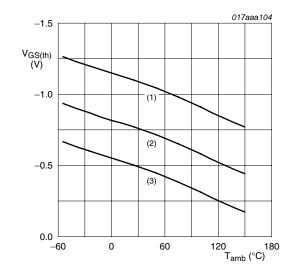
(2)
$$T_{amb} = 25 \, ^{\circ}C$$

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



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

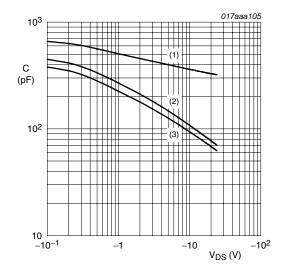
Fig 11. Normalized drain-source on-state resistance as a function of ambient temperature; typical values



 $I_D = -0.25 \text{ mA}; V_{DS} = V_{GS}$

- (1) maximum values
- (2) typical values
- (3) minimum values

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

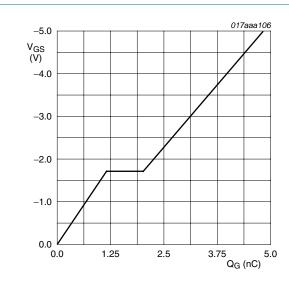


f = 1 MHz; V_{GS} = 0 V

- (1) C_{iss}
- (2) Coss
- (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

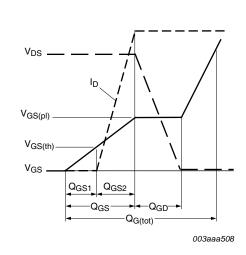
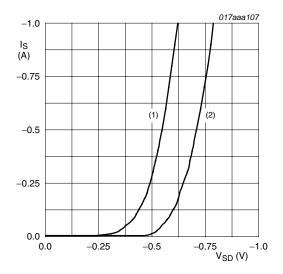


Fig 15. Gate charge waveform definitions



 $V_{GS} = 0 V$

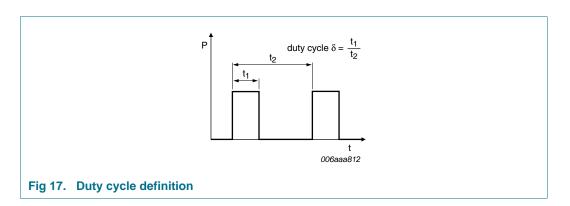
(1) $T_{amb} = 150 \, ^{\circ}C$

(2) $T_{amb} = 25 \, ^{\circ}C$

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

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8. Test information



8.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard *Q101 - Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

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9. Package outline

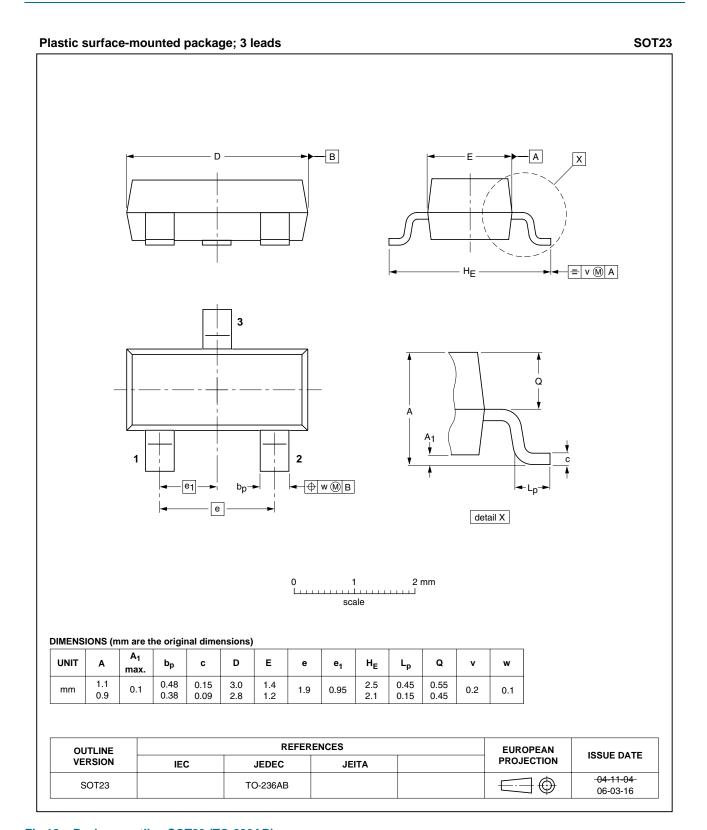


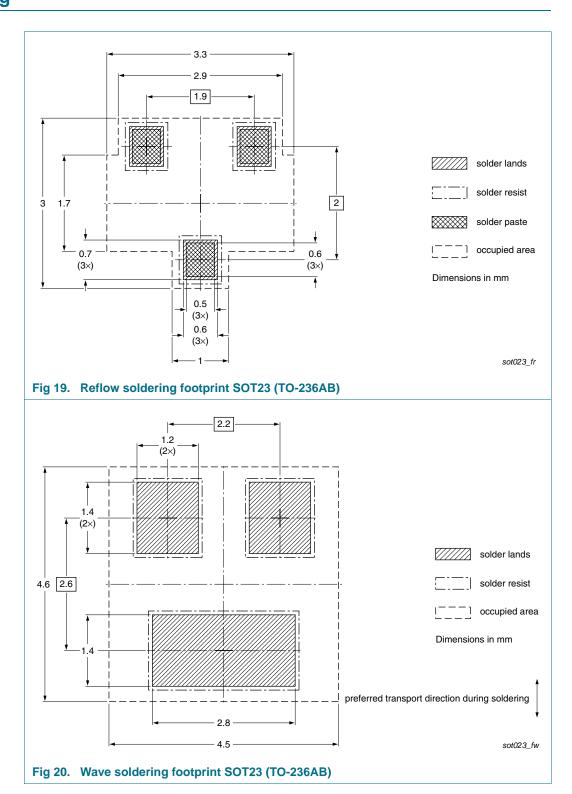
Fig 18. Package outline SOT23 (TO-236AB)

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10. Soldering



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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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