



# NX7002BKS

60 V, dual N-channel Trench MOSFET

12 May 2015

Product data sheet

## 1. General description

Dual N-channel enhancement mode Field-Effect Transistor (FET) in a very small SOT363 (SC-88) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

## 2. Features and benefits

- Logic-level compatible
- Very fast switching
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection > 2 kV HBM

## 3. Applications

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

## 4. Quick reference data

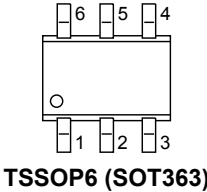
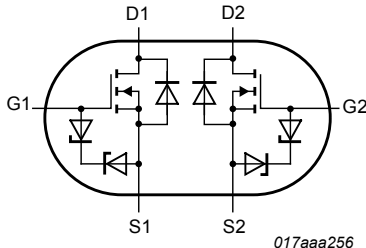
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	60	V
$V_{GS}$	gate-source voltage		-20	-	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{sp} = 25\text{ °C}$	-	-	330	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	240	mA
<b>Static characteristics (per transistor)</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 200\text{ mA}; T_j = 25\text{ °C}$	-	2.2	2.8	$\Omega$

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain  $1\text{ cm}^2$ .

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source TR1	 <p>TSSOP6 (SOT363)</p>	 <p>017aaa256</p>
2	G1	gate TR1		
3	D2	drain TR2		
4	S2	source TR2		
5	G2	gate TR2		
6	D1	drain TR1		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NX7002BKS	TSSOP6	plastic surface-mounted package; 6 leads	SOT363

## 7. Marking

Table 4. Marking codes

Type number	Marking code
NX7002BKS	LT% [1]

[1] % = placeholder for manufacturing site code

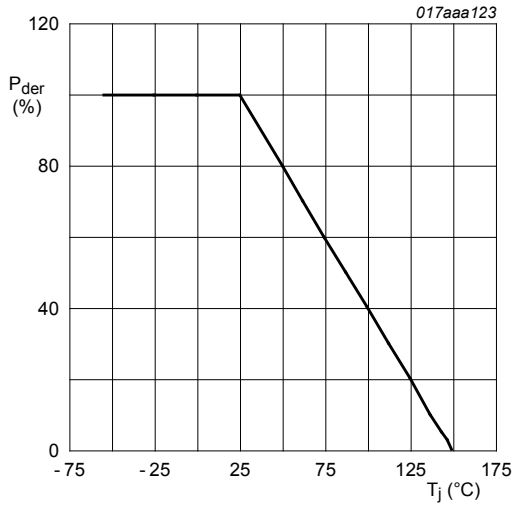
## 8. Limiting values

**Table 5. Limiting values**

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

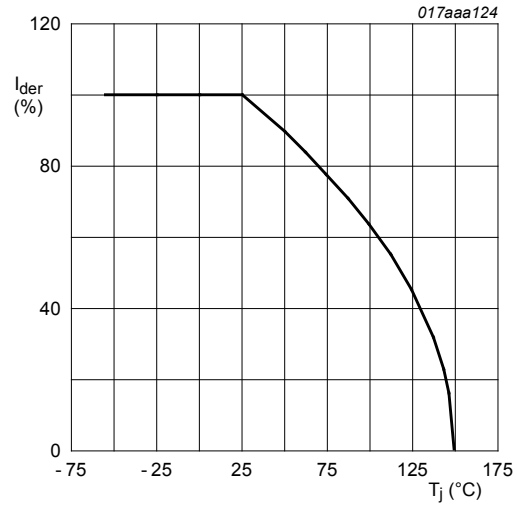
Symbol	Parameter	Conditions		Min	Max	Unit
<b>Per transistor</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$		-	60	V
$V_{GS}$	gate-source voltage			-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{sp} = 25\text{ °C}$		-	330	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	240	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 100\text{ °C}$	[1]	-	150	mA
$I_{DM}$	peak drain current	$T_{amb} = 25\text{ °C};$ single pulse; $t_p \leq 10\text{ }\mu\text{s}$		-	0.8	A
$P_{tot}$	total power dissipation	$T_{amb} = 25\text{ °C}$	[2]	-	285	mW
			[1]	-	320	mW
		$T_{sp} = 25\text{ °C}$		-	870	mW
<b>Source-drain diode</b>						
$I_S$	source current	$T_{amb} = 25\text{ °C}$	[1]	-	200	mA
<b>Per device</b>						
$T_j$	junction temperature			-55	150	°C
$T_{amb}$	ambient temperature			-55	150	°C
$T_{stg}$	storage temperature			-65	150	°C

- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain  $1\text{ cm}^2$ .
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.



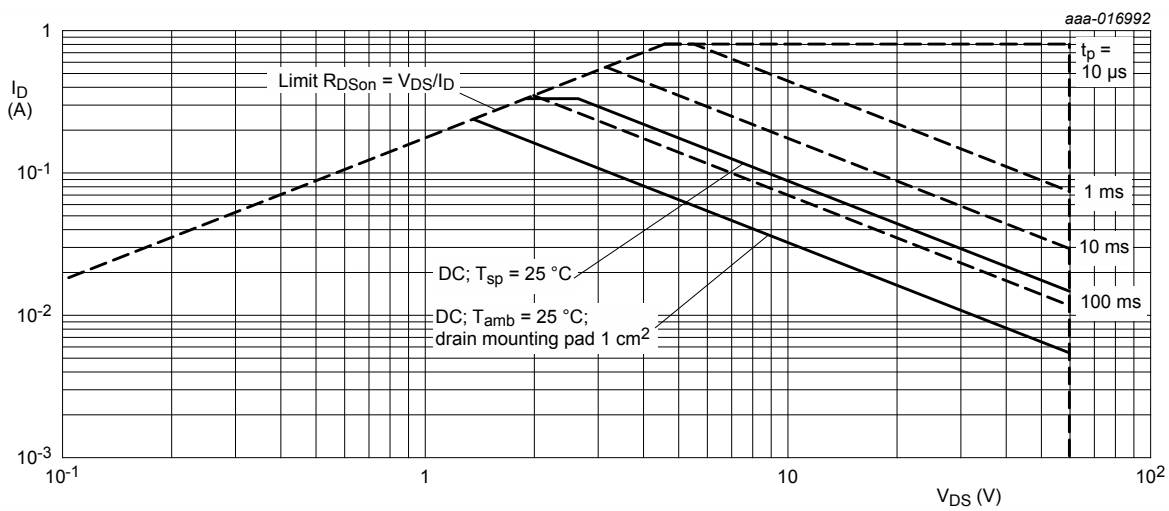
**Fig. 1. MOSFET transistor: Normalized total power dissipation as a function of junction temperature**

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



**Fig. 2. MOSFET transistor: Normalized continuous drain current as a function of junction temperature**

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



I<sub>DM</sub> = single pulse

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

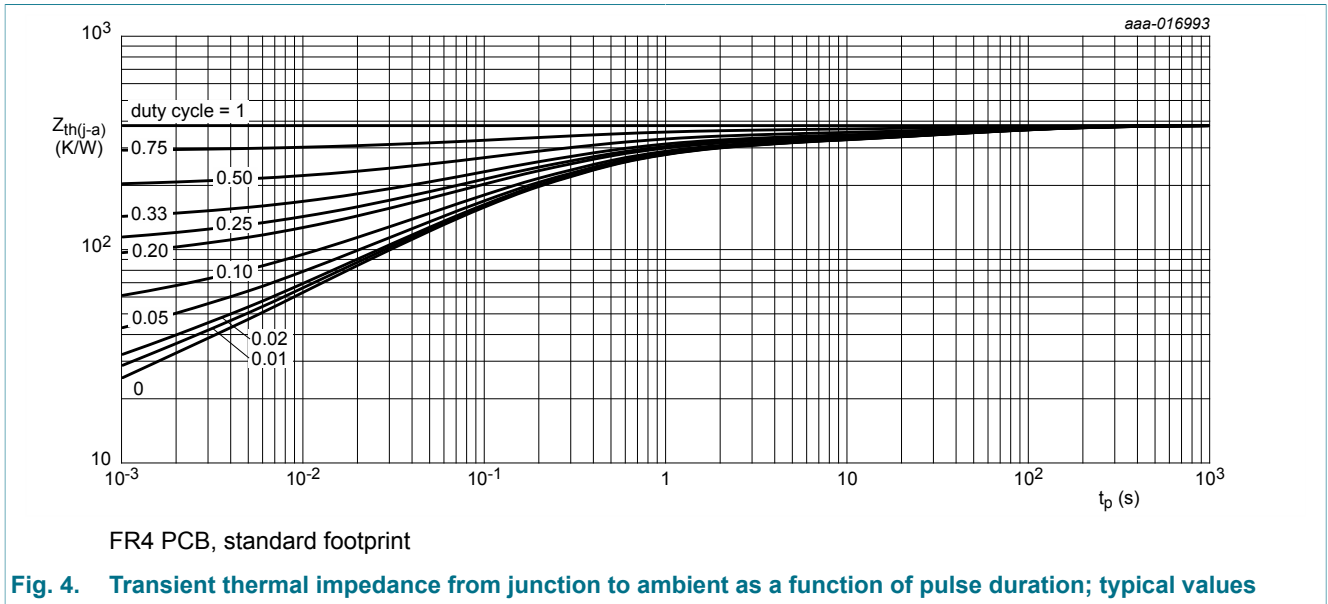
## 9. Thermal characteristics

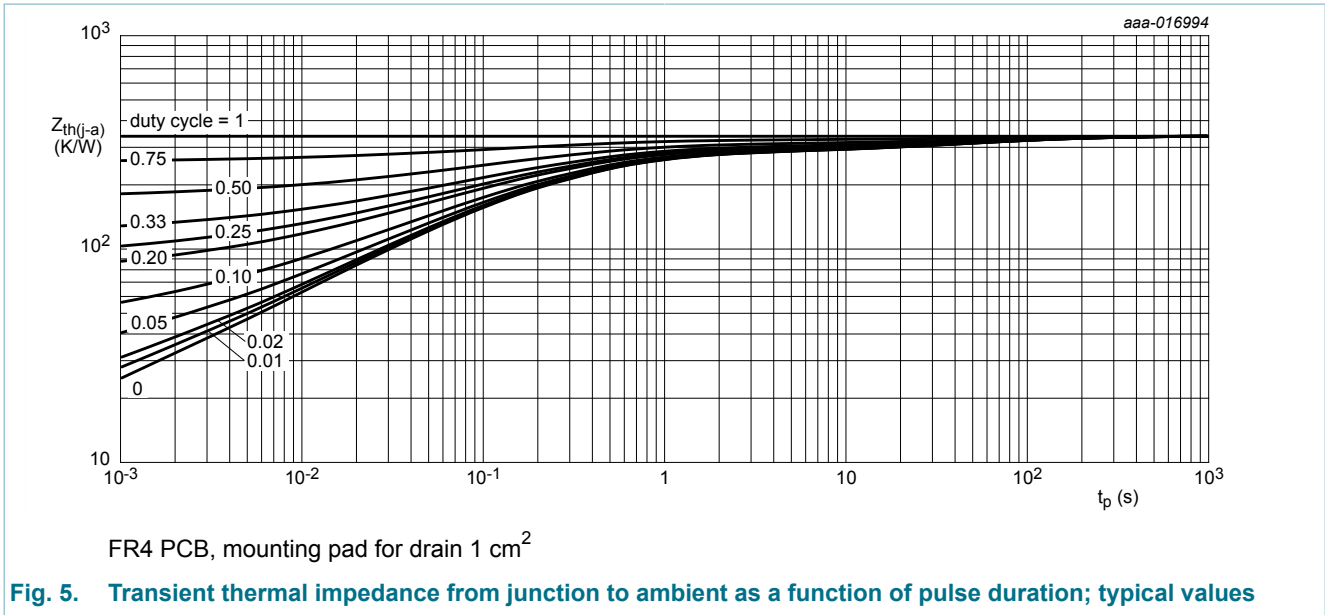
Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	380	440	K/W
			[2]	-	340	390	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	125	145	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 and mounting pad for drain 1 cm<sup>2</sup>.

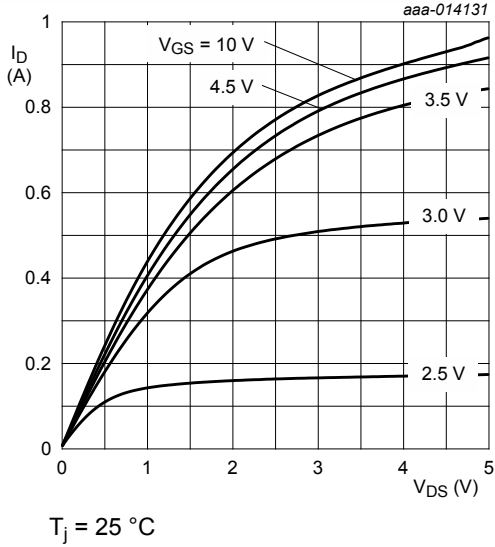




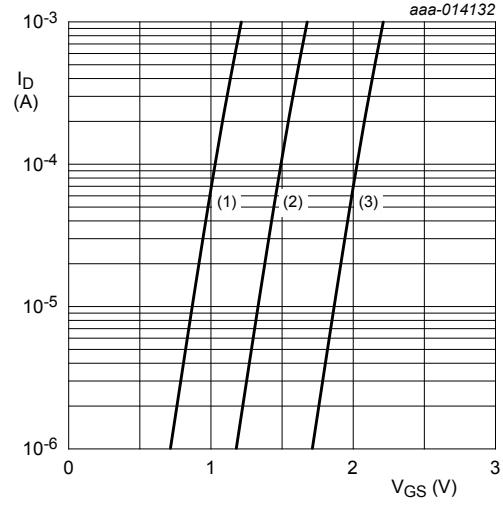
## 10. Characteristics

Table 7. Characteristics

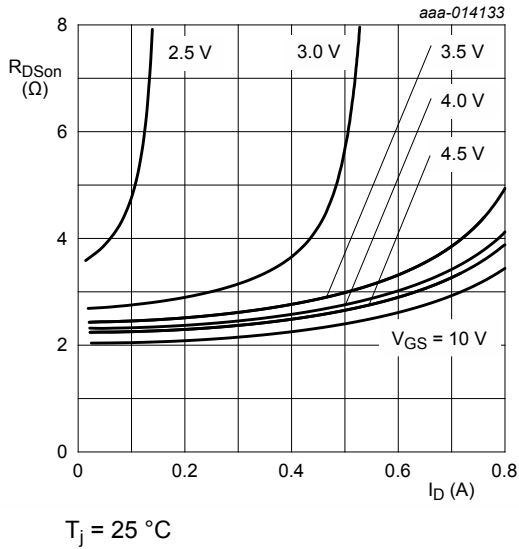
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics (per transistor)</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	60	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ C$	1.1	1.6	2.1	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	1	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	10	$\mu A$
		$V_{GS} = -20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	-10	$\mu A$
		$V_{GS} = 10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	1	$\mu A$
		$V_{GS} = -10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	-1	$\mu A$
		$V_{GS} = 5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	0.3	$\mu A$
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 200 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	2.2	2.8	$\Omega$
		$V_{GS} = 10 V$ ; $I_D = 200 \text{ mA}$ ; $T_j = 150 \text{ }^\circ C$	-	4.5	5.7	$\Omega$
		$V_{GS} = 5 V$ ; $I_D = 200 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	2.5	3.2	$\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = 10 V$ ; $I_D = 200 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	600	-	mS
$R_G$	gate resistance	$f = 1 \text{ MHz}$	-	2.5	-	$\Omega$
<b>Dynamic characteristics (per transistor)</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 V$ ; $I_D = 200 \text{ mA}$ ; $V_{GS} = 10 V$ ; $T_j = 25 \text{ }^\circ C$	-	1	-	nC
$Q_{GS}$	gate-source charge		-	0.12	-	nC
$Q_{GD}$	gate-drain charge		-	0.18	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 10 V$ ; $f = 1 \text{ MHz}$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	23.6	-	pF
$C_{oss}$	output capacitance		-	4.6	-	pF
$C_{riss}$	reverse transfer capacitance		-	3	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 50 V$ ; $I_D = 200 \text{ mA}$ ; $V_{GS} = 10 V$ ; $R_{G(ext)} = 6 \Omega$ ; $T_j = 25 \text{ }^\circ C$	-	4.7	-	ns
$t_r$	rise time		-	4.3	-	ns
$t_{d(off)}$	turn-off delay time		-	6.9	-	ns
$t_f$	fall time		-	2.9	-	ns
<b>Source-drain diode (per transistor)</b>						
$V_{SD}$	source-drain voltage	$I_S = 50 \text{ mA}$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	0.87	1.2	V



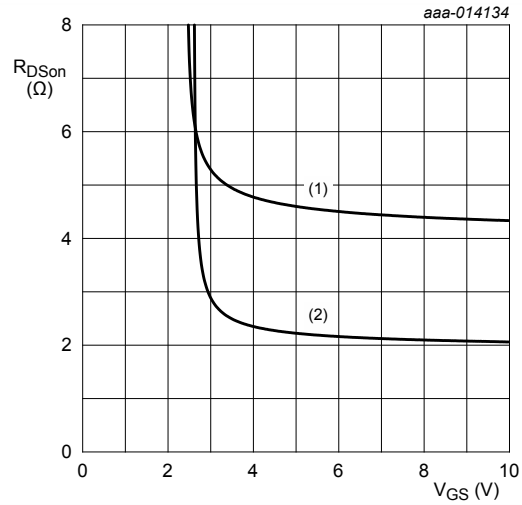
**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



**Fig. 7. Sub-threshold drain current as a function of gate-source voltage**  
 (1) minimum values  
 (2) typical values  
 (3) maximum values

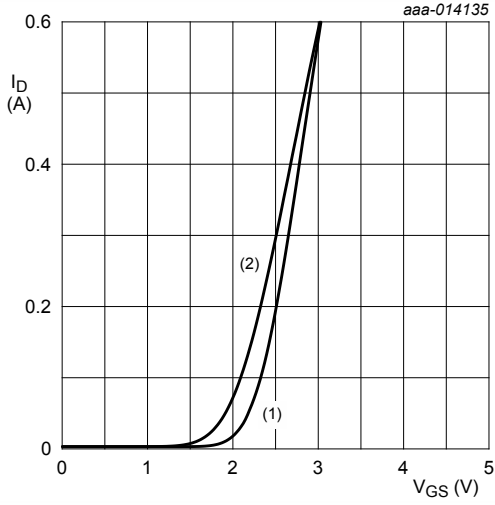


**Fig. 8. Drain-source on-state resistance as a function of drain current; typical values**



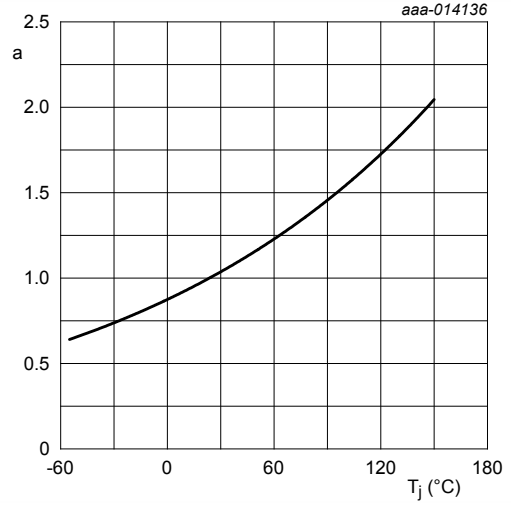
**Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values**  
 (1)  $T_j = 150^\circ\text{C}$   
 (2)  $T_j = 25^\circ\text{C}$





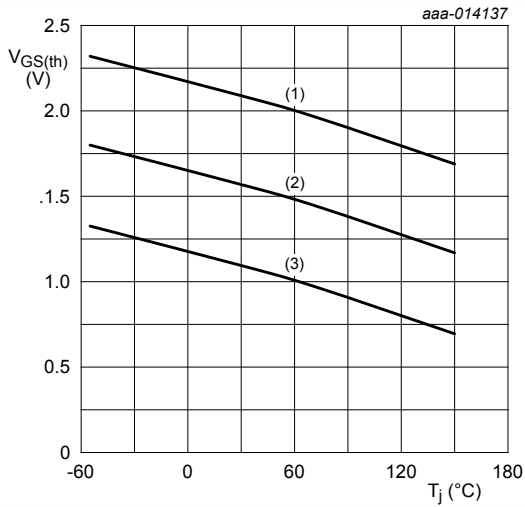
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25\text{ °C}$   
 (2)  $T_j = 150\text{ °C}$

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



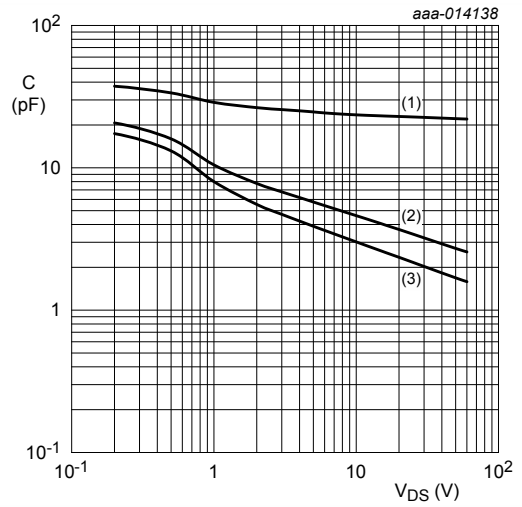
**Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values**

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



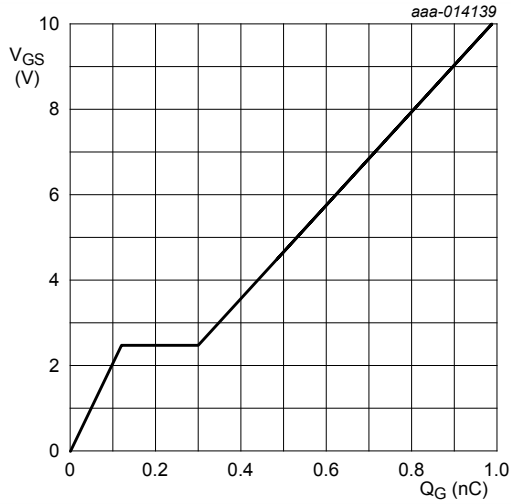
$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$   
 (1) maximum values  
 (2) typical values  
 (3) minimum values

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



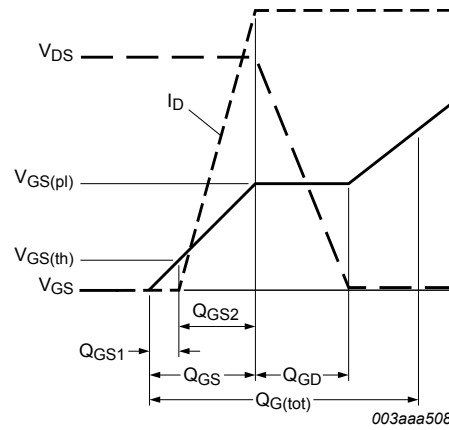
$f = 1\text{ MHz}; V_{GS} = 0\text{ V}$   
 (1)  $C_{iss}$   
 (2)  $C_{oss}$   
 (3)  $C_{rss}$

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

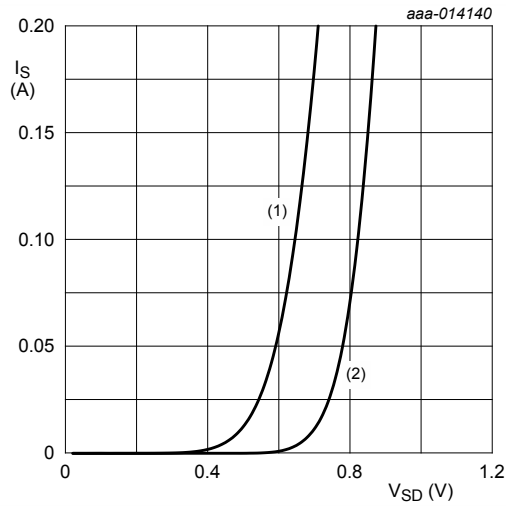


$I_D = 0.2 \text{ A}$ ;  $V_{DS} = 30 \text{ V}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$

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



**Fig. 15. MOSFET transistor: Gate charge waveform definitions**



$V_{GS} = 0 \text{ V}$   
 (1)  $T_j = 150 \text{ }^\circ\text{C}$   
 (2)  $T_j = 25 \text{ }^\circ\text{C}$

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

### 11. Test information

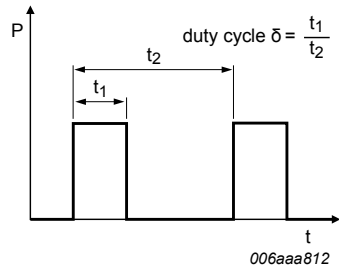


Fig. 17. Duty cycle definition

### 12. Package outline

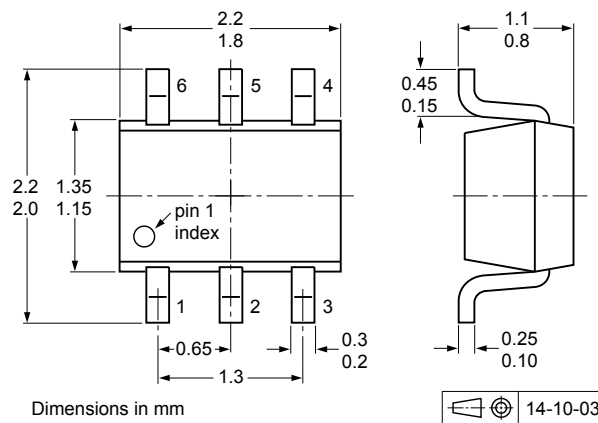


Fig. 18. Package outline TSSOP6 (SOT363)

### 13. Soldering

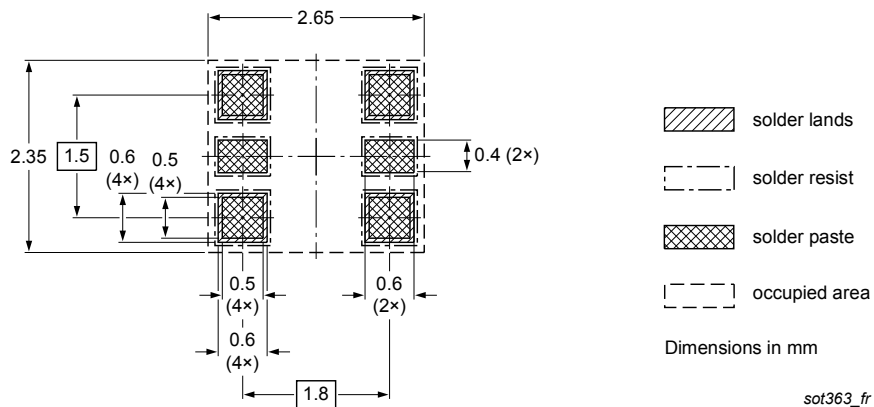


Fig. 19. Reflow soldering footprint for TSSOP6 (SOT363)

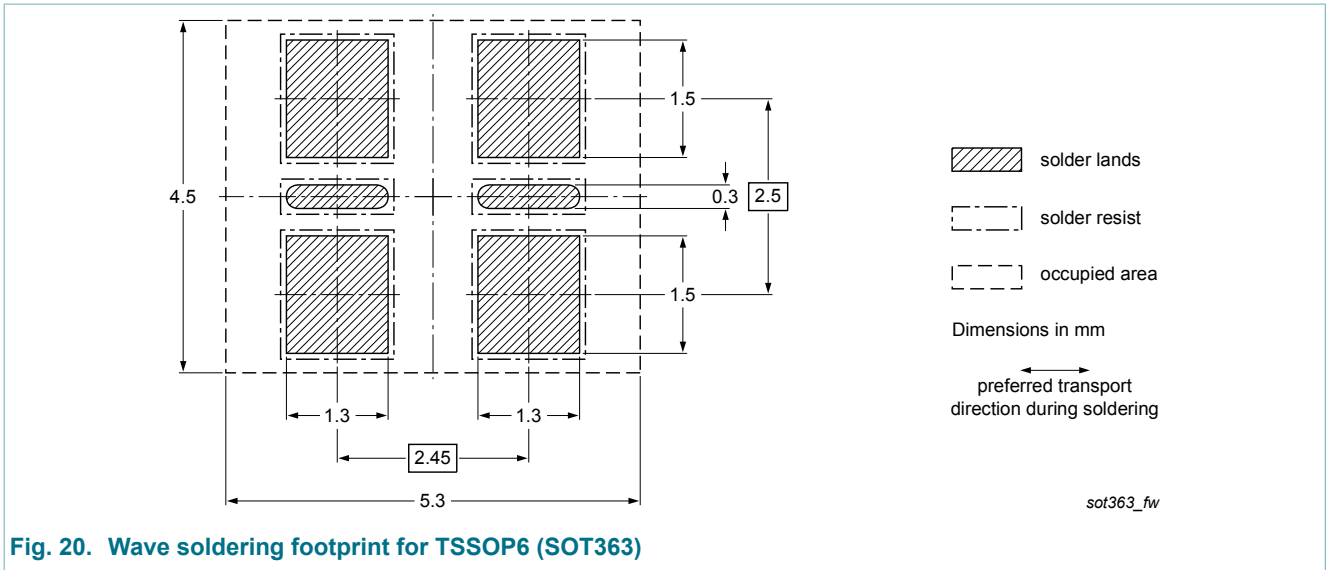


Fig. 20. Wave soldering footprint for TSSOP6 (SOT363)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NX7002BKS v.1	20150512	Product data sheet	-	-

## 15. Legal information

### 15.1 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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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