



# THE DATASHEET OF NX7002AK





# NX7002AKS

60 V, dual N-channel Trench MOSFET

Rev. 1 — 1 March 2012

Product data sheet

## 1. Product profile

### 1.1 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.

### 1.2 Features and benefits

- Very fast switching
- Trench MOSFET technology
- ESD protection

### 1.3 Applications

- Relay driver
- High-speed line driver
- Low-side load switch
- Switching circuits

### 1.4 Quick reference data

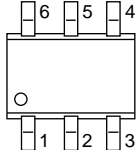
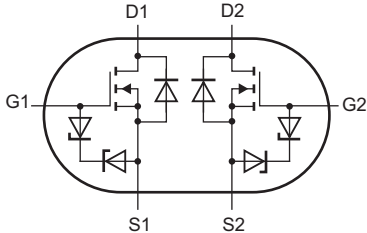
Table 1. Quick reference data

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	$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	170	mA
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 100\text{ mA}; T_j = 25\text{ °C}$	-	3	4.5	$\Omega$

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 1 cm<sup>2</sup>.

## 2. Pinning information

Table 2. Pinning information

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

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NX7002AKS	TSSOP6	plastic surface-mounted package; 6 leads	SOT363

## 4. Marking

Table 4. Marking codes

Type number	Marking code <sup>[1]</sup>
NX7002AKS	TD%

[1] % = placeholder for manufacturing site code

## 5. Limiting values

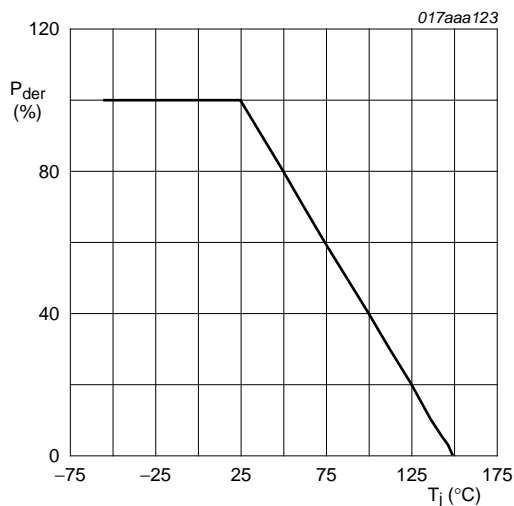
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit	
<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	$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	170	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 100\text{ °C}$	[1]	-	100	mA
$I_{DM}$	peak drain current	$T_{amb} = 25\text{ °C};$ single pulse; $t_p \leq 10\text{ }\mu\text{s}$	-	680	mA	
$P_{tot}$	total power dissipation	$T_{amb} = 25\text{ °C}$	[2]	-	220	mW
			[1]	-	255	mW
		$T_{sp} = 25\text{ °C}$	-	1060	mW	
<b>Source-drain diode</b>						
$I_S$	source current	$T_{amb} = 25\text{ °C}$	[1]	-	170	mA
<b>Per device</b>						
$P_{tot}$	total power dissipation	$T_{amb} = 25\text{ °C}$	[2]	-	330	mW
$T_j$	junction temperature		-55	150	°C	
$T_{amb}$	ambient temperature		-55	150	°C	
$T_{stg}$	storage temperature		-65	150	°C	

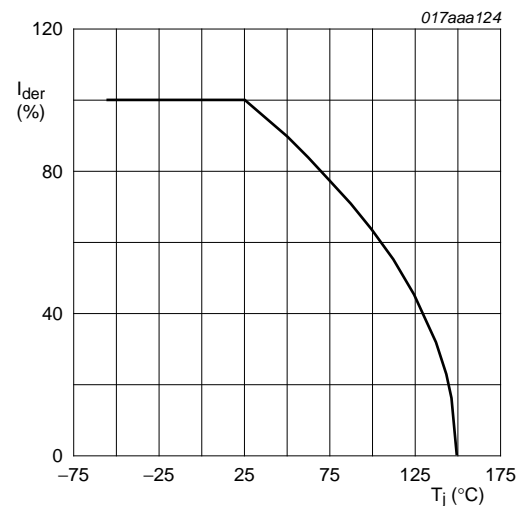
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 1 cm<sup>2</sup>.

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



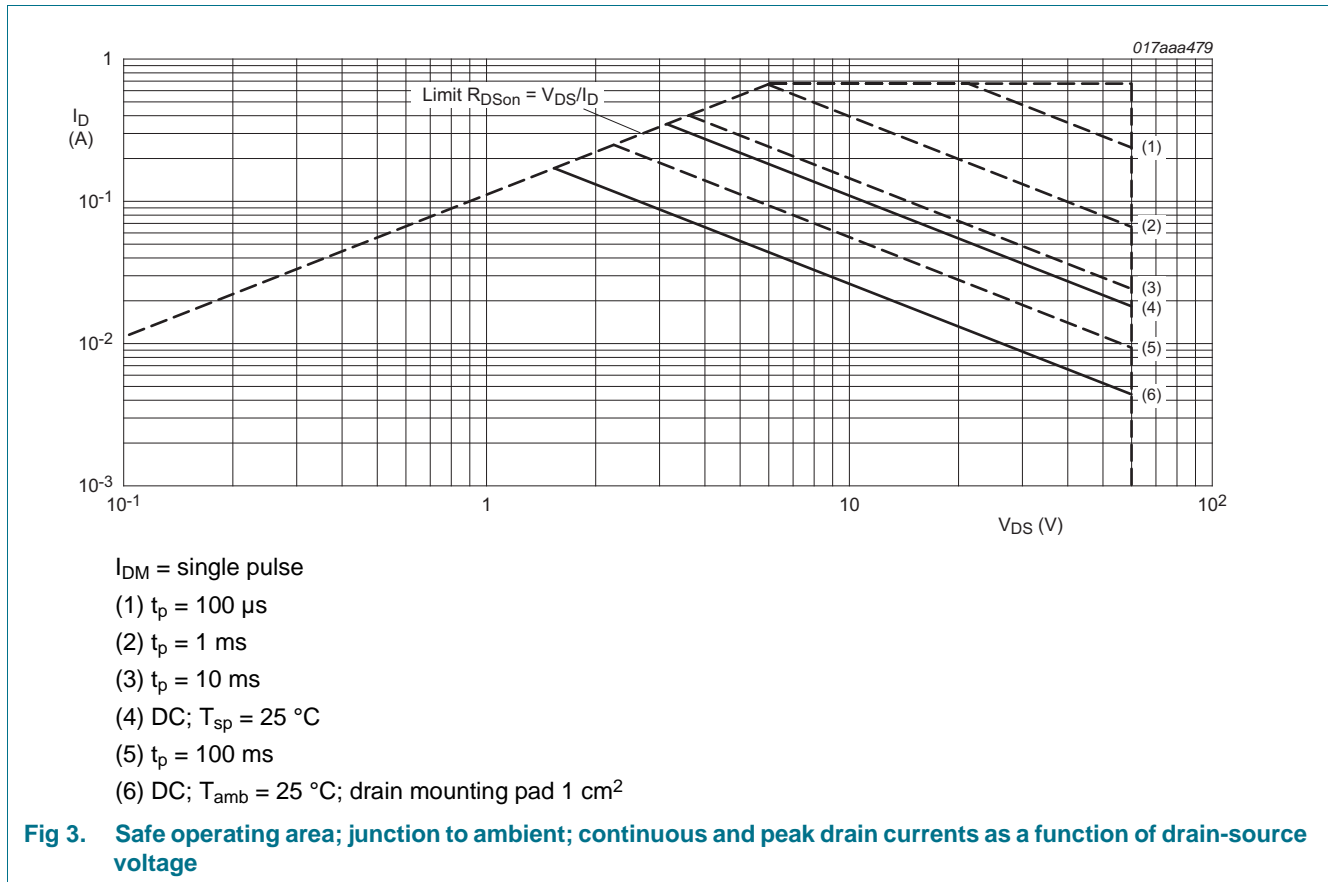
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ\text{C})}} \times 100\%$$

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



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

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



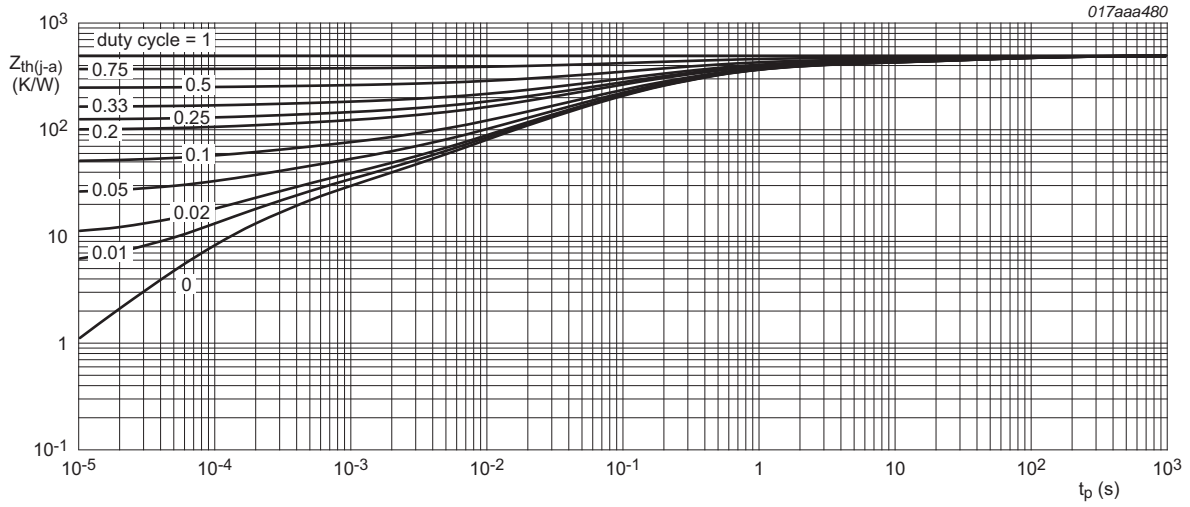
## 6. Thermal characteristics

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]	-	500	560 K/W
			[2]	-	450	480 K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	115	K/W

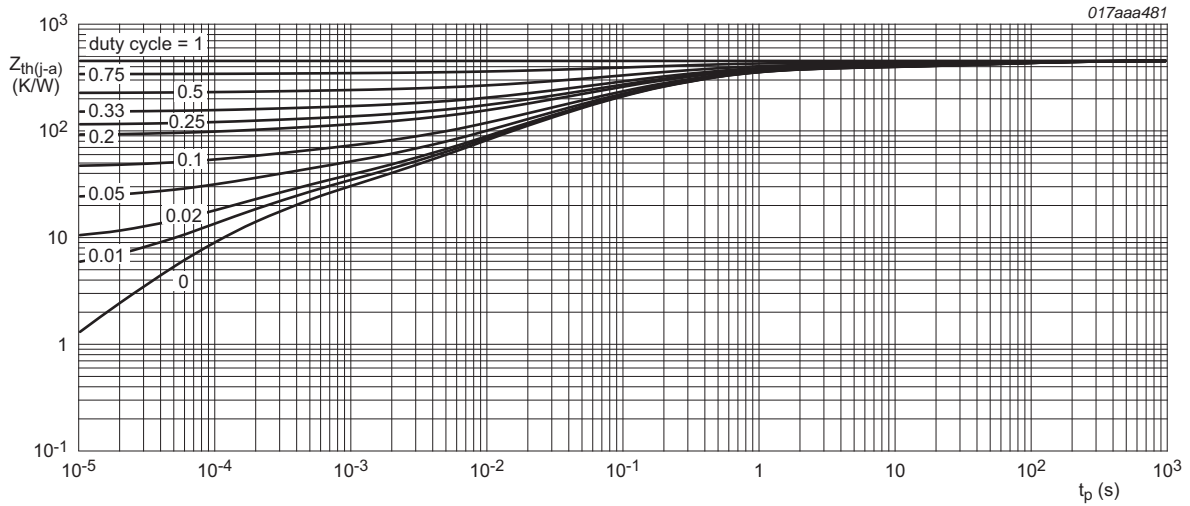
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

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



FR4 PCB, standard footprint

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



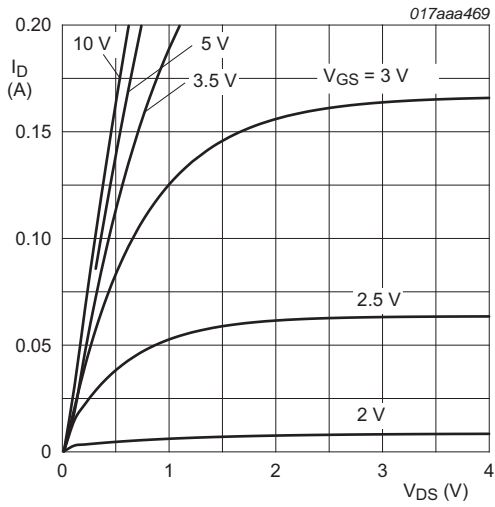
FR4 PCB, mounting pad for drain 1 cm<sup>2</sup>

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

## 7. Characteristics

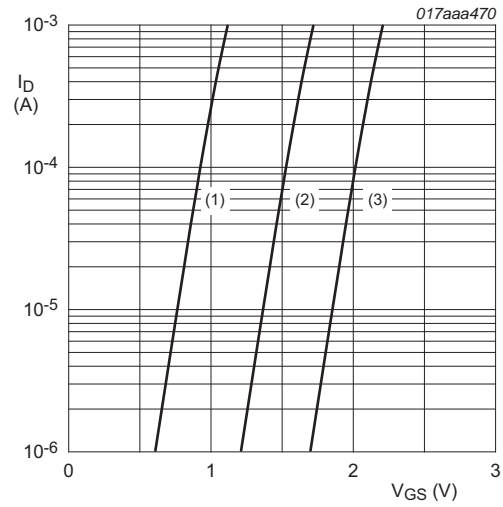
Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	60	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ\text{C}$	1.1	1.6	2.1	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	1	$\mu A$
		$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 150 \text{ }^\circ\text{C}$	-	-	10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	2	$\mu A$
		$V_{GS} = -20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	2	$\mu A$
		$V_{GS} = 10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	0.5	$\mu A$
		$V_{GS} = -10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	0.5	$\mu A$
		$V_{GS} = 5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	100	nA
		$V_{GS} = -5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	-	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 100 \text{ mA}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	3	4.5	$\Omega$
		$V_{GS} = 10 V$ ; $I_D = 100 \text{ mA}$ ; $T_j = 150 \text{ }^\circ\text{C}$	-	6.2	9.2	$\Omega$
		$V_{GS} = 5 V$ ; $I_D = 100 \text{ mA}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	3.7	5.2	$\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = 10 V$ ; $I_D = 200 \text{ mA}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	230	-	mS
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 V$ ; $I_D = 200 \text{ mA}$ ; $V_{GS} = 4.5 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	0.33	0.43	nC
$Q_{GS}$	gate-source charge		-	0.12	-	nC
$Q_{GD}$	gate-drain charge		-	0.09	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 10 V$ ; $f = 1 \text{ MHz}$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	11	17	pF
$C_{oss}$	output capacitance		-	3.4	-	pF
$C_{rSS}$	reverse transfer capacitance		-	1.4	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 40 V$ ; $R_L = 250 \Omega$ ; $V_{GS} = 10 V$ ; $R_{G(ext)} = 6 \Omega$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	6	12	ns
$t_r$	rise time		-	7	-	ns
$t_{d(off)}$	turn-off delay time		-	20	40	ns
$t_f$	fall time		-	14	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 115 \text{ mA}$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ\text{C}$	0.47	0.7	1.2	V



$T_j = 25\text{ °C}$

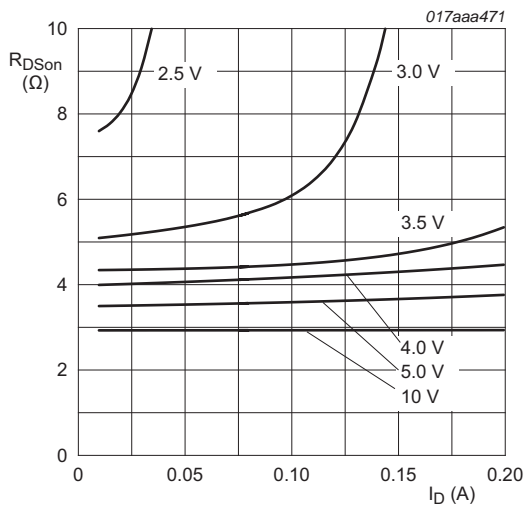
**Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



$T_j = 25\text{ °C}$ ;  $V_{DS} = 5\text{ V}$

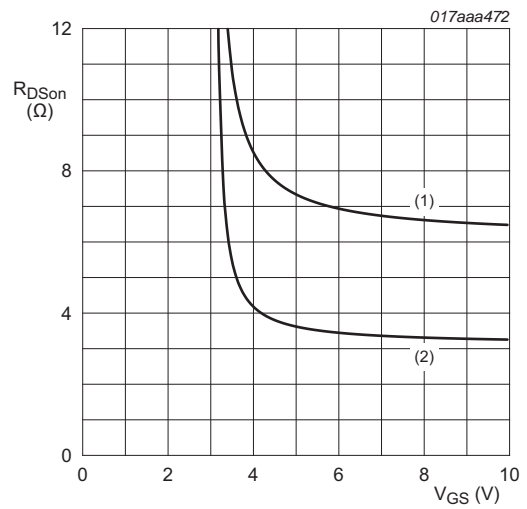
- (1) minimum values
- (2) typical values
- (3) maximum values

**Fig 7. Subthreshold drain current as a function of gate-source voltage**



$T_j = 25\text{ °C}$

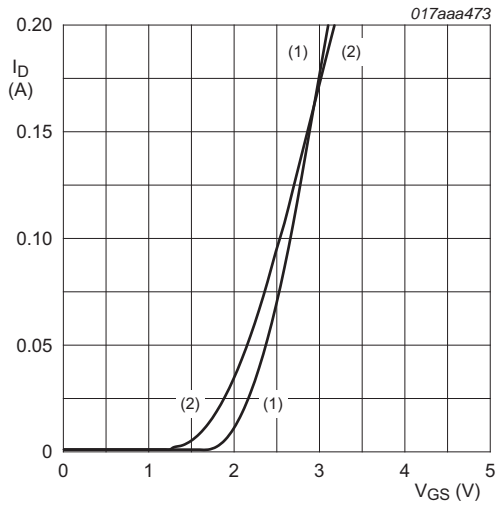
**Fig 8. Drain-source on-state resistance as a function of drain current; typical values**



$I_D = 0.2\text{ A}$

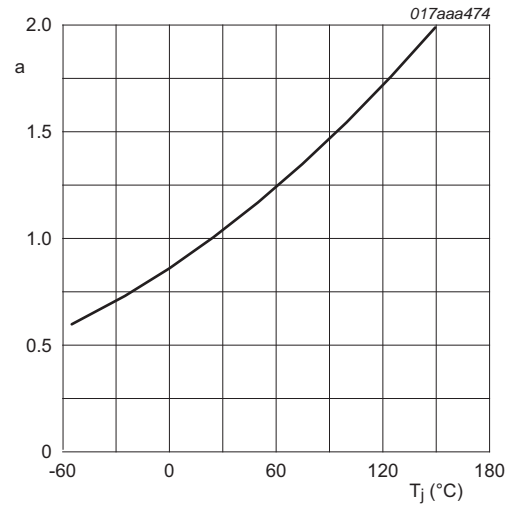
- (1)  $T_j = 150\text{ °C}$
- (2)  $T_j = 25\text{ °C}$

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



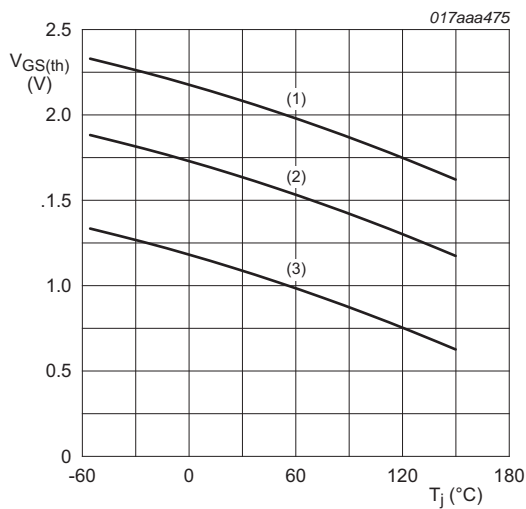
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25\text{ }^\circ\text{C}$   
 (2)  $T_j = 150\text{ }^\circ\text{C}$

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



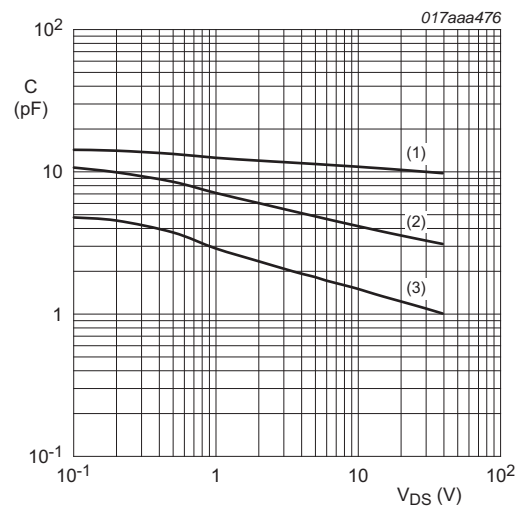
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25^\circ\text{C})}}$$

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



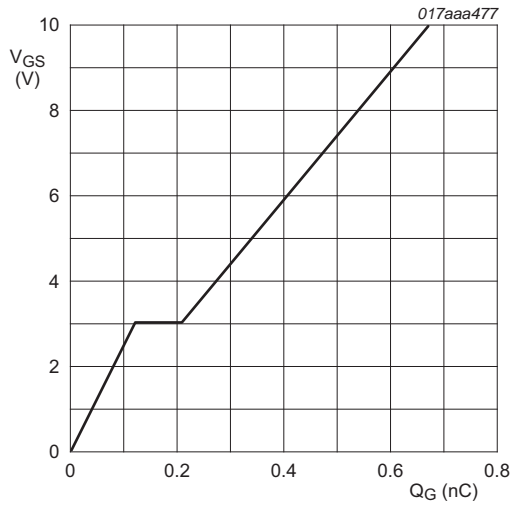
$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$   
 (1) maximum values  
 (2) typical values  
 (3) minimum values

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



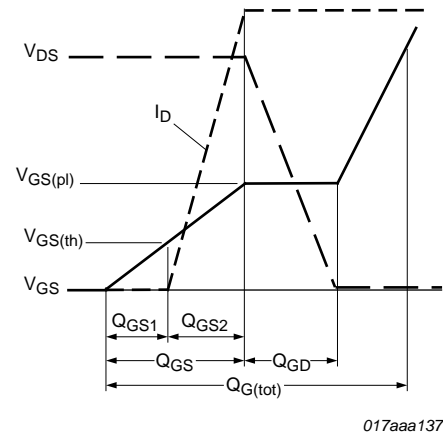
$f = 1\text{ MHz}; V_{GS} = 0\text{ V}$   
 (1)  $C_{iss}$   
 (2)  $C_{oss}$   
 (3)  $C_{rss}$

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

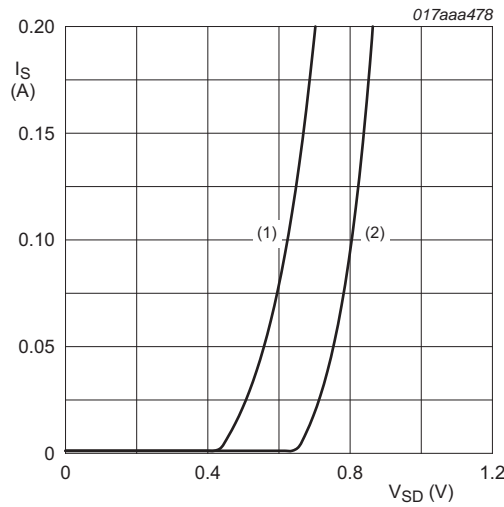


$I_D = 0.2 \text{ A}; V_{DS} = 30 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

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



**Fig 15. 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**

## 8. Test information

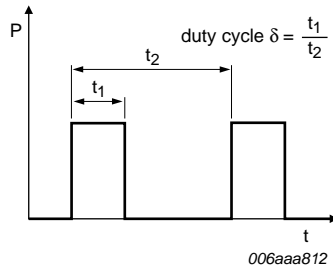


Fig 17. Duty cycle definition

## 9. Package outline

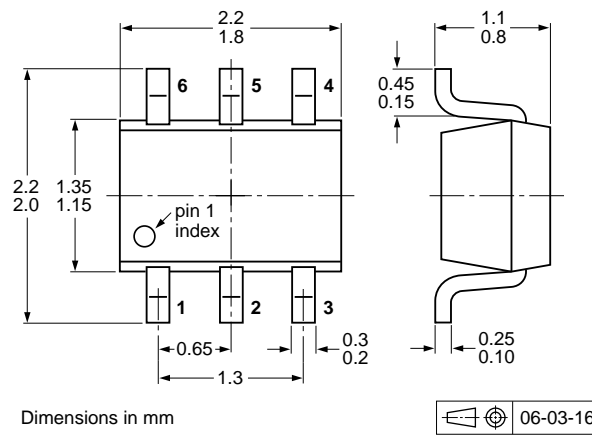
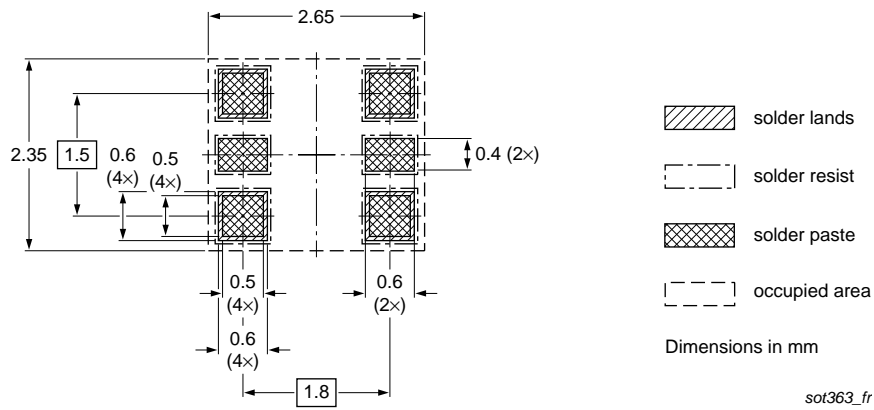
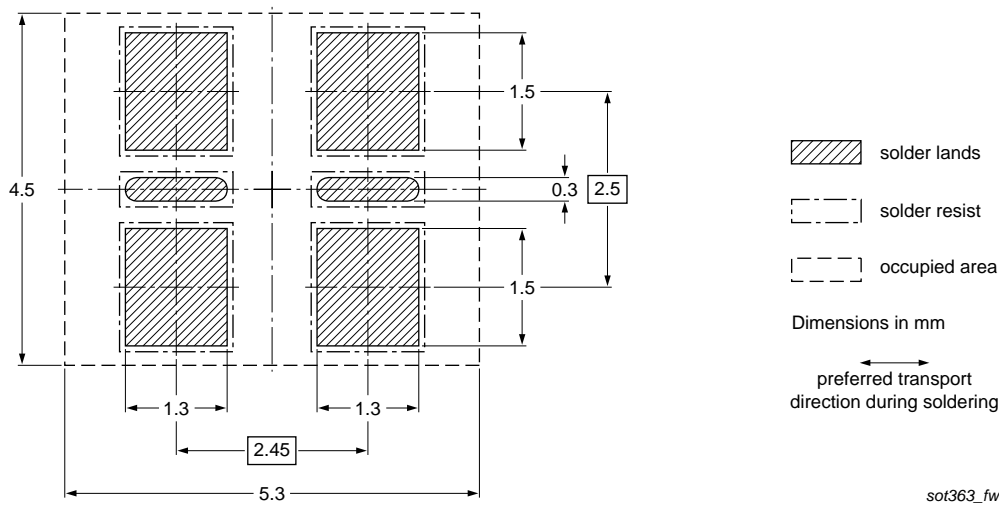


Fig 18. Package outline SOT363 (TSSOP6)

## 10. Soldering



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



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

## 11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX7002AKS v.1	20120301	Product data sheet	-	-

## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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