



# 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

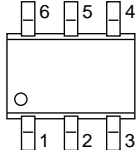
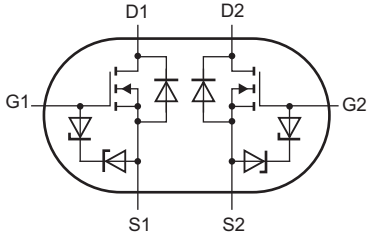
Table 1. Quick reference data

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

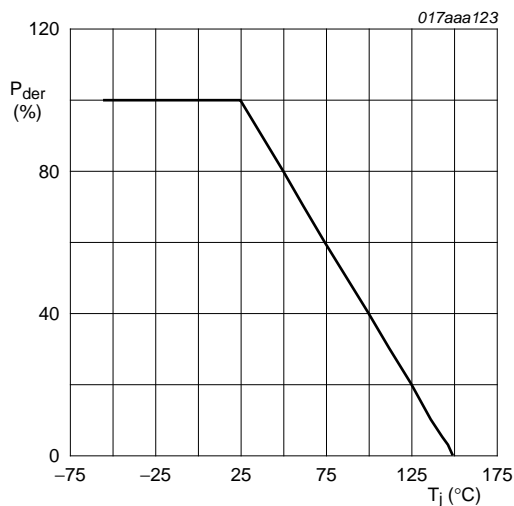
**Table 5. Limiting values**

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	

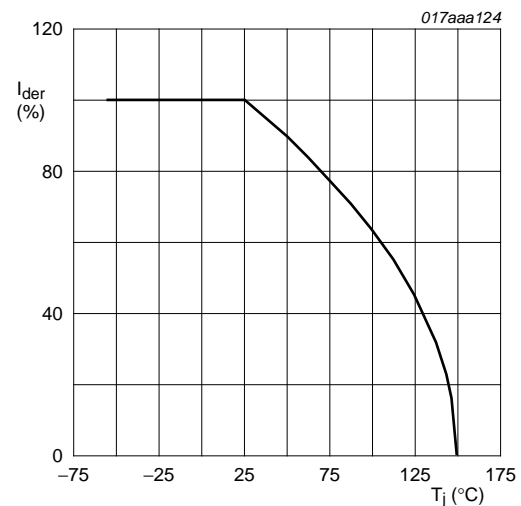
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 1 cm<sup>2</sup>.

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



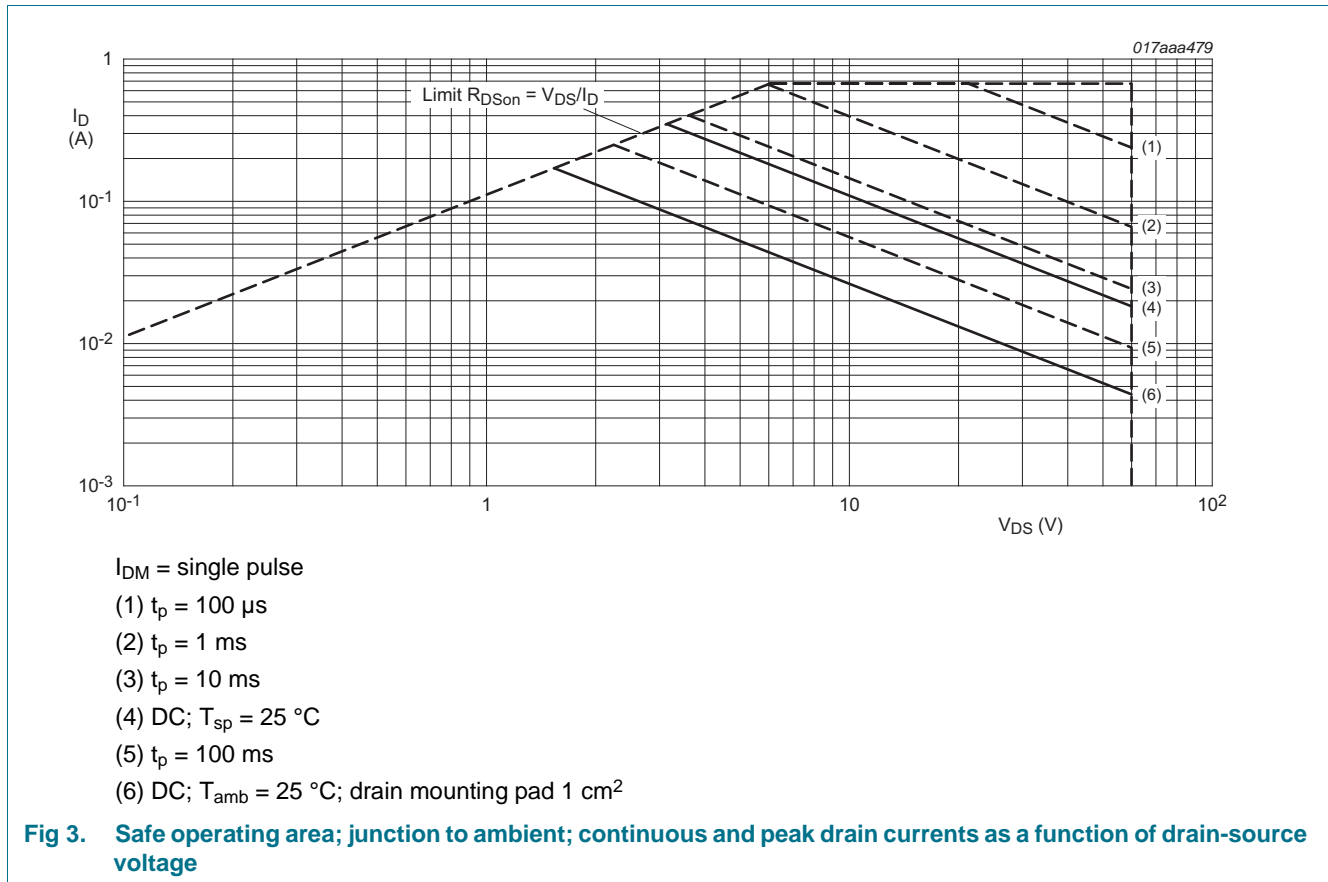
$$P_{der} = \frac{P_{tot}}{P_{tot(25\text{ °C})}} \times 100\%$$

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



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

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



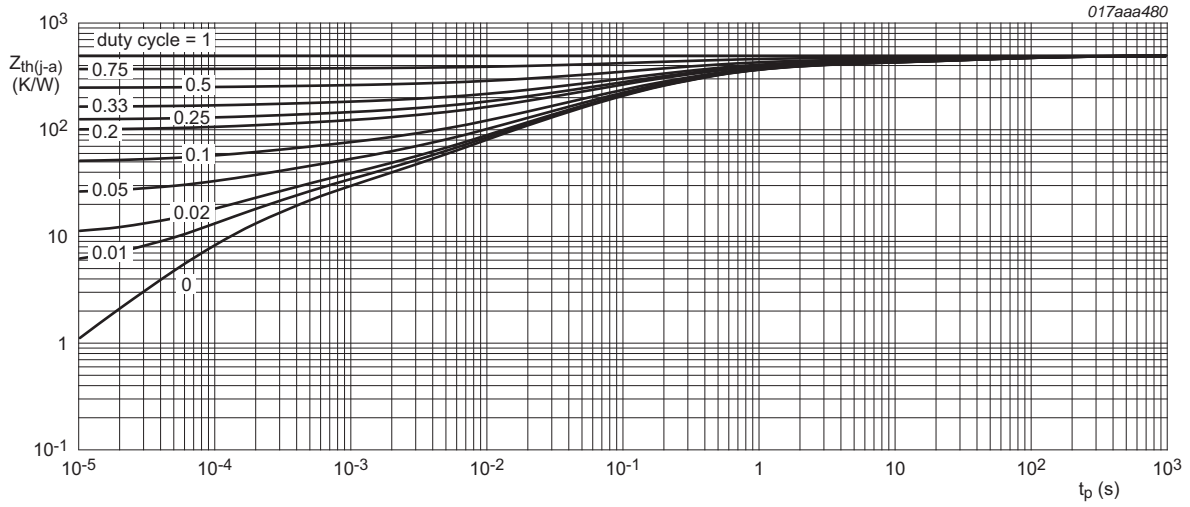
## 6. Thermal characteristics

**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	

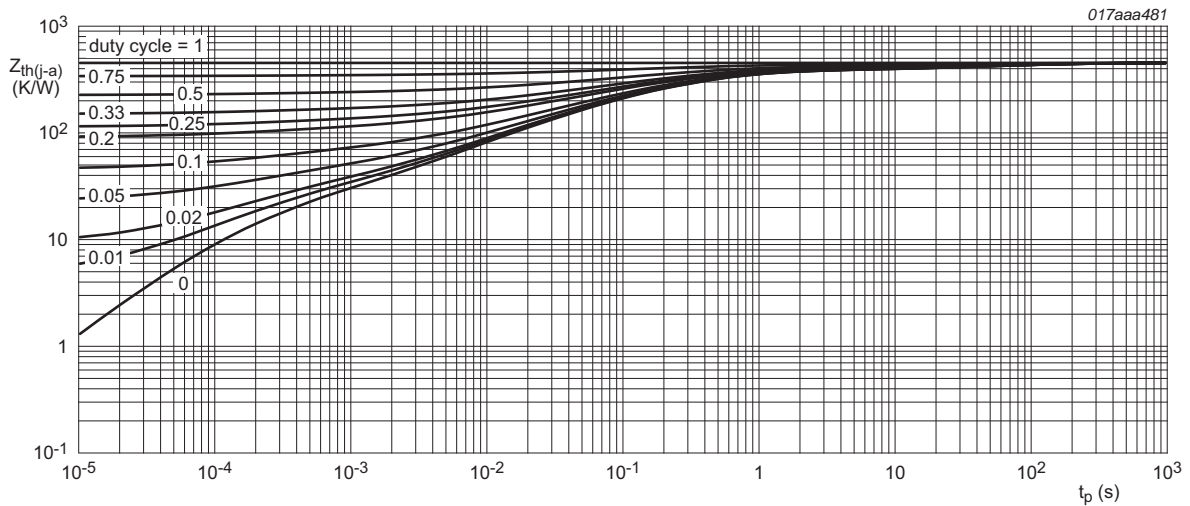
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[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**



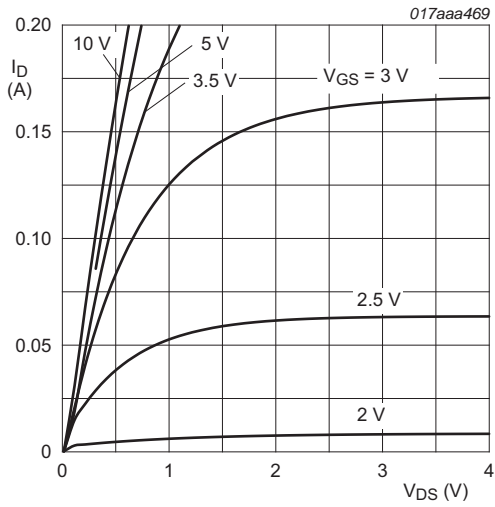
FR4 PCB, mounting pad for drain 1 cm<sup>2</sup>

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

## 7. Characteristics

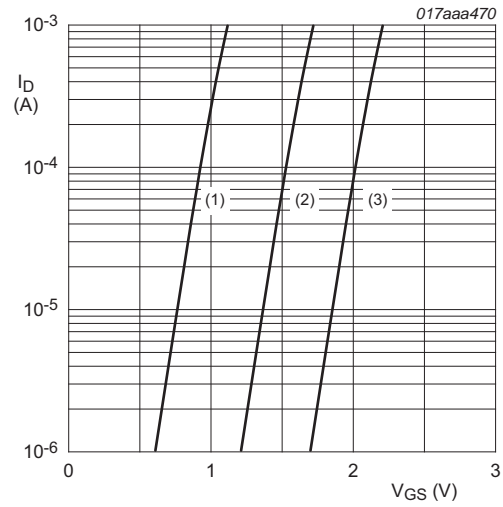
Table 7. Characteristics

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



$T_j = 25\text{ °C}$

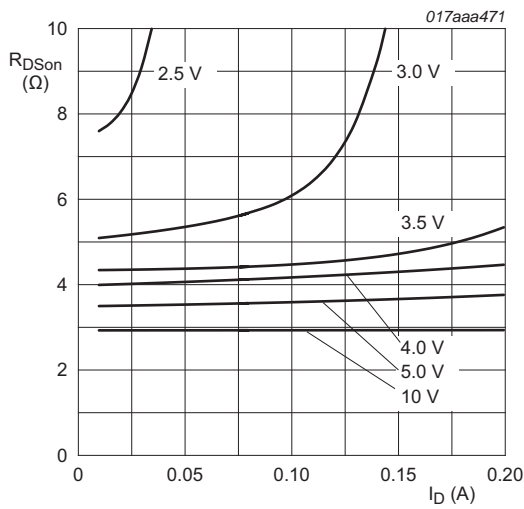
**Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



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

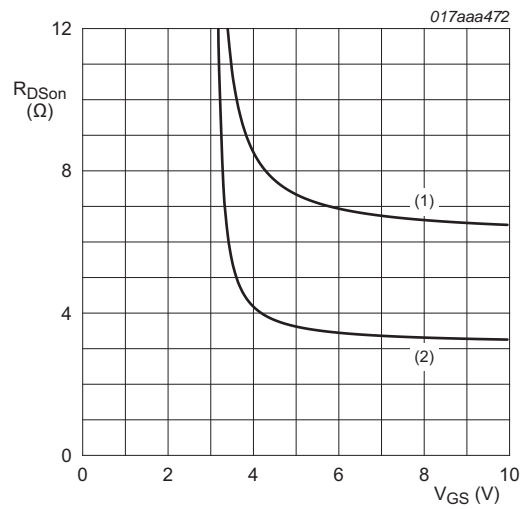
- (1) minimum values
- (2) typical values
- (3) maximum values

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



$T_j = 25\text{ °C}$

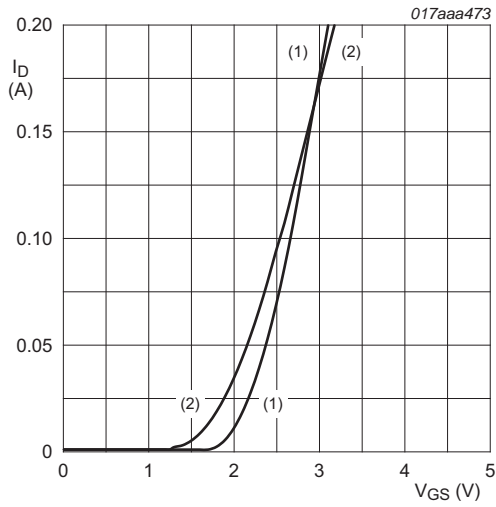
**Fig 8. Drain-source on-state resistance as a function of drain current; typical values**



$I_D = 0.2\text{ A}$

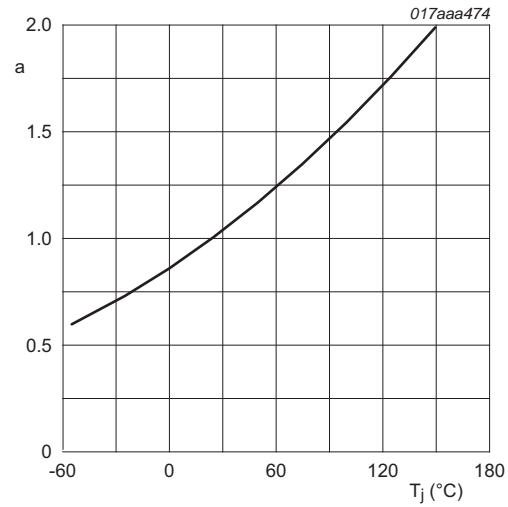
- (1)  $T_j = 150\text{ °C}$
- (2)  $T_j = 25\text{ °C}$

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



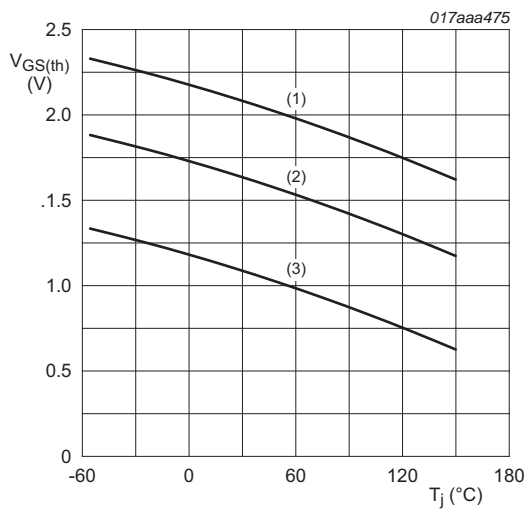
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25\text{ }^\circ\text{C}$   
 (2)  $T_j = 150\text{ }^\circ\text{C}$

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



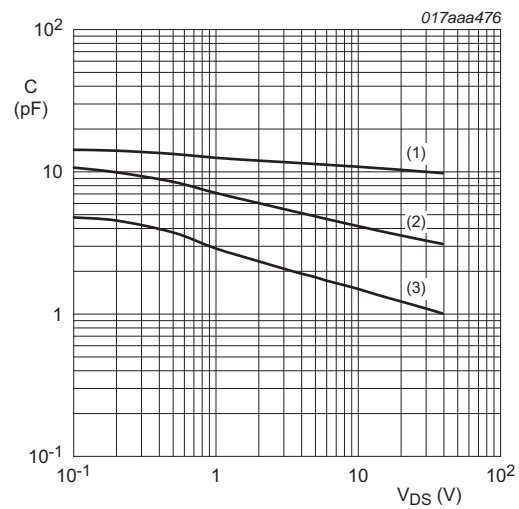
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25^\circ\text{C})}}$$

**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

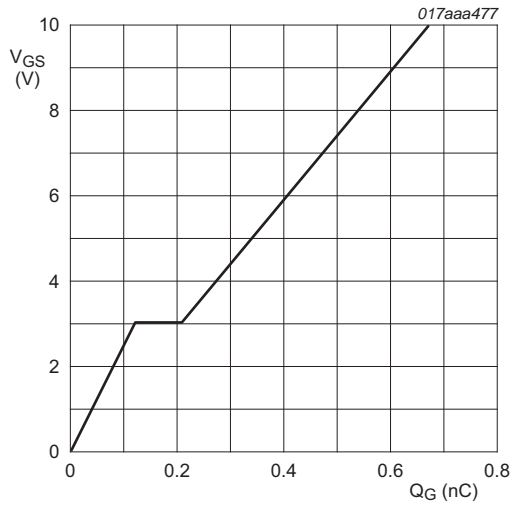
**Fig 12. Gate-source threshold voltage as a function of junction temperature**



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

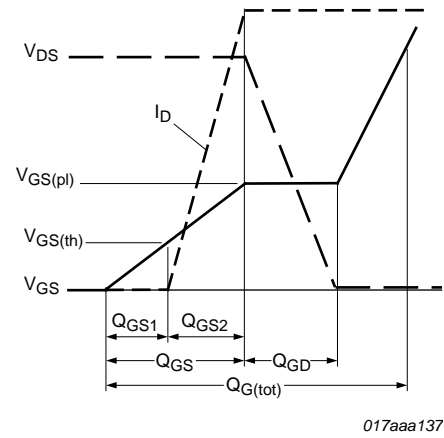
**Fig 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



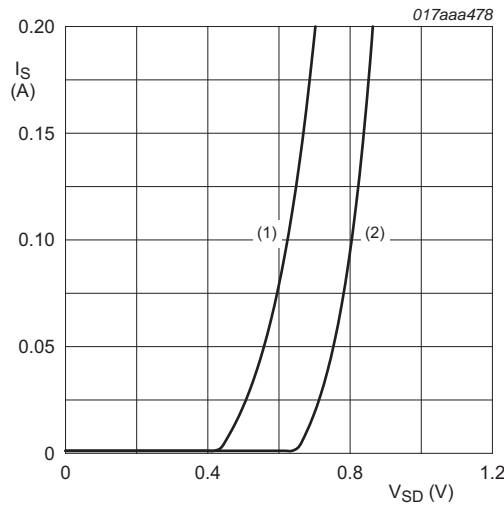


$I_D = 0.2 \text{ A}; V_{DS} = 30 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

**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

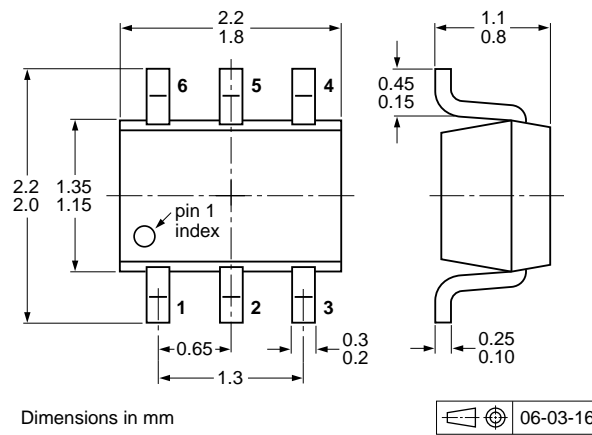
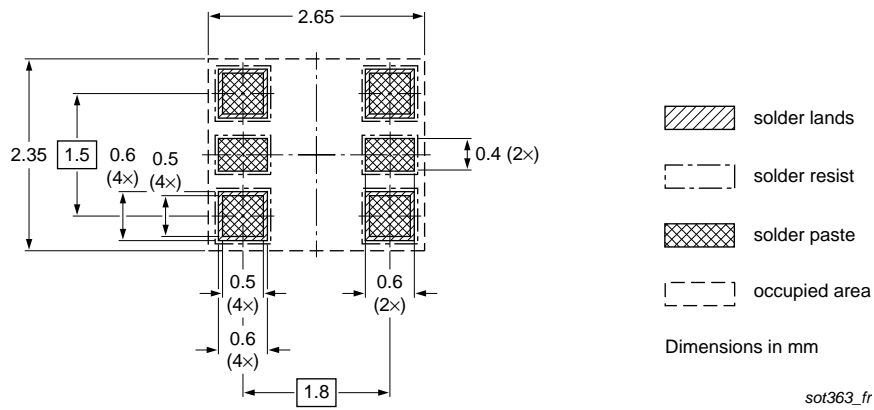
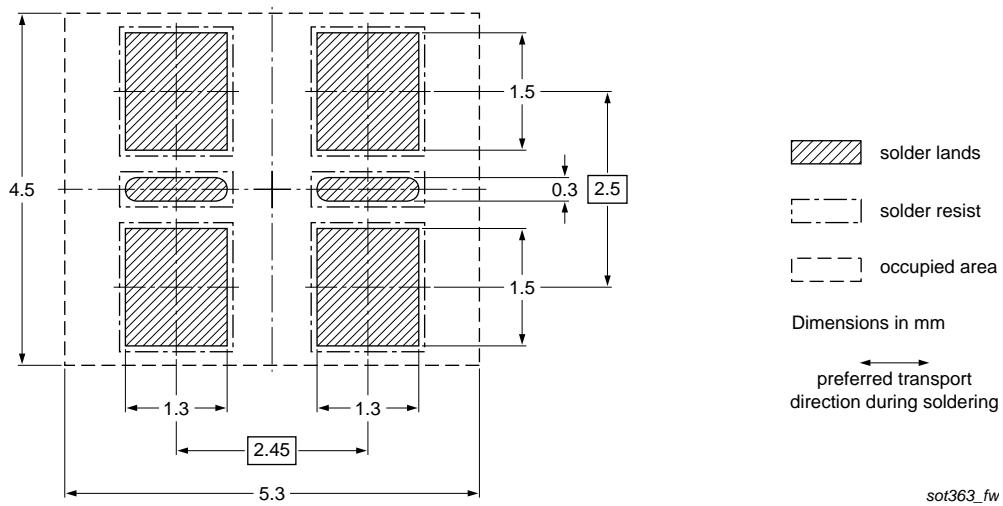


Fig 18. Package outline SOT363 (TSSOP6)

**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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

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