

# NX7002AKW

60 V, single N-channel Trench MOSFET

11 July 2012

Product data sheet

## 1. Product profile

### 1.1 General description

N-channel enhancement mode Field-Effect Transistor (FET) in a small SOT323 (SC-70) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

### 1.2 Features and benefits

- Very fast switching
- Trench MOSFET technology
- ESD protected

### 1.3 Applications

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

### 1.4 Quick reference data

Table 1. Quick reference data

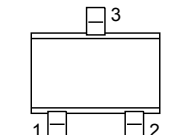
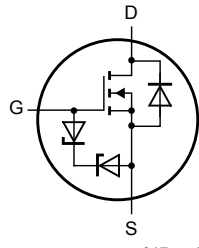
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	60	V
$V_{GS}$	gate-source voltage		-20	-	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	170	mA
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 100\text{ mA}; T_j = 25\text{ °C}$	-	3	4.5	$\Omega$

[1] Device mounted on an FR4 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	G	gate	 <p>SC-70 (SOT323)</p>	 <p>017aaa255</p>
2	S	source		
3	D	drain		

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NX7002AKW	SC-70	plastic surface-mounted package; 3 leads	SOT323

## 4. Marking

Table 4. Marking codes

Type number	Marking code
NX7002AKW	AH% [1]

[1] % = placeholder for manufacturing site code

## 5. Limiting values

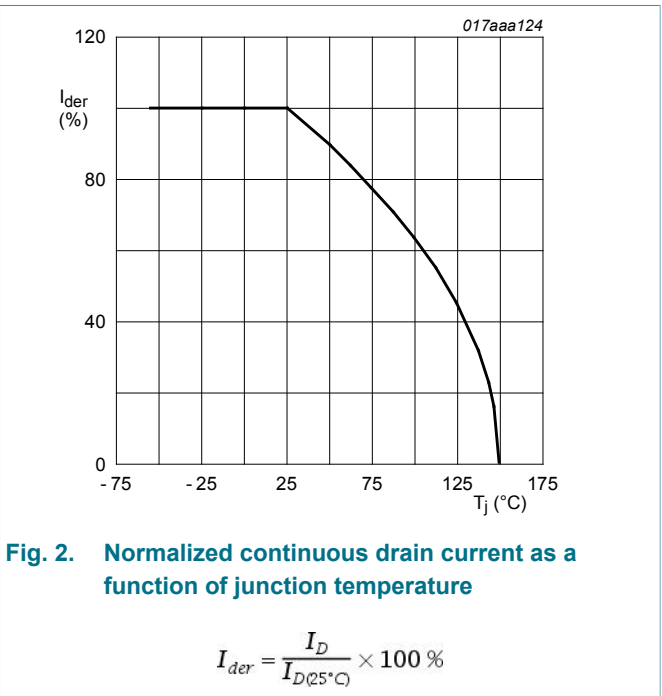
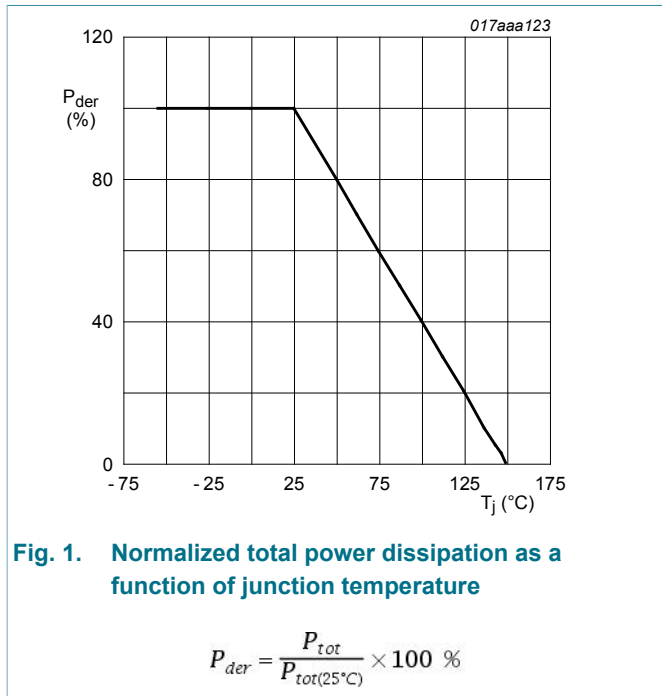
Table 5. Limiting values

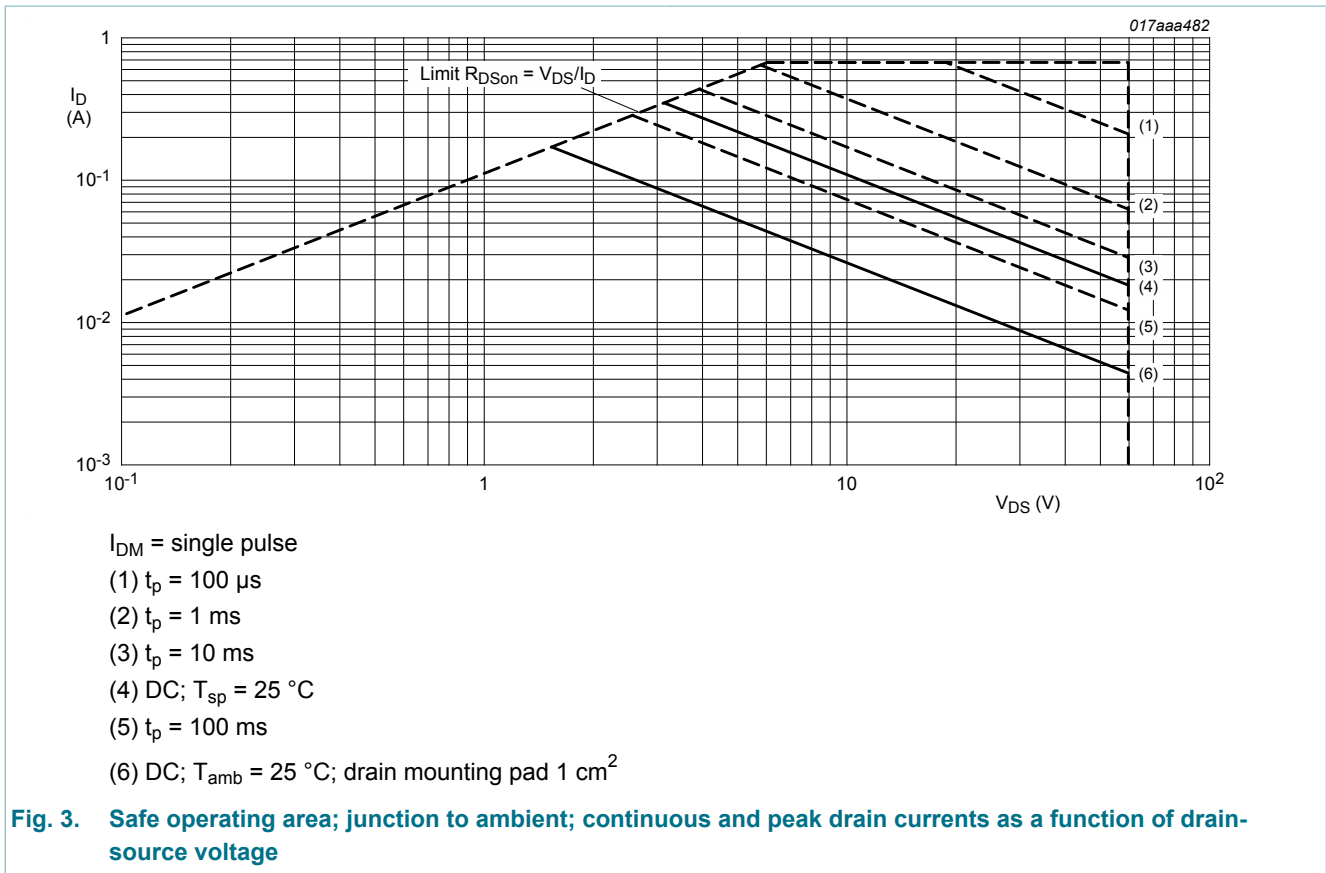
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	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

Symbol	Parameter	Conditions		Min	Max	Unit
		T <sub>sp</sub> = 25 °C		-	1060	mW
T <sub>j</sub>	junction temperature			-55	150	°C
T <sub>amb</sub>	ambient temperature			-55	150	°C
T <sub>stg</sub>	storage temperature			-65	150	°C
<b>Source-drain diode</b>						
I <sub>s</sub>	source current	T <sub>amb</sub> = 25 °C	[1]	-	170	mA

- [1] Device mounted on an FR4 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.





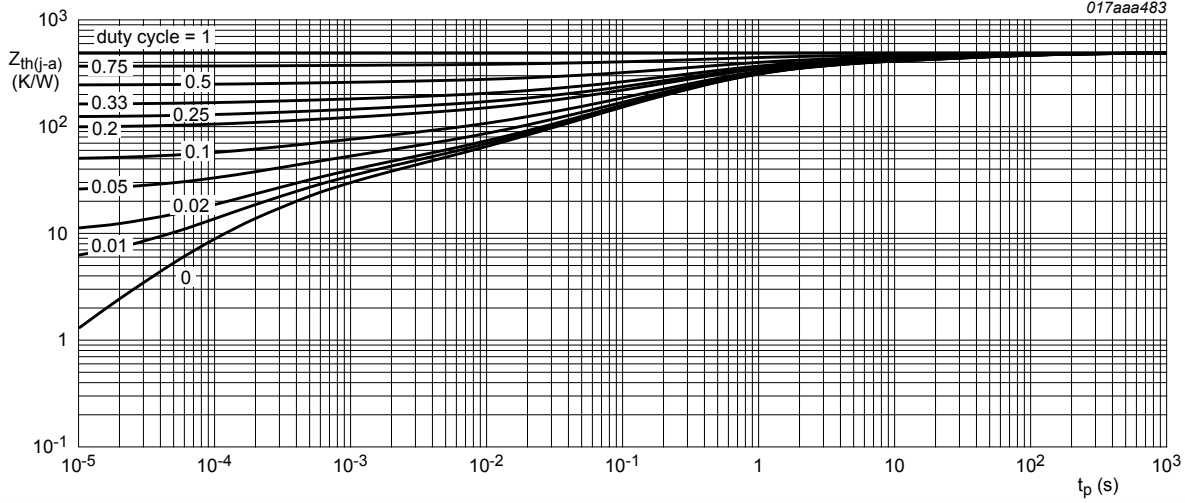
## 6. Thermal characteristics

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]	-	485	560	K/W
			[2]	-	420	480	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	115	K/W

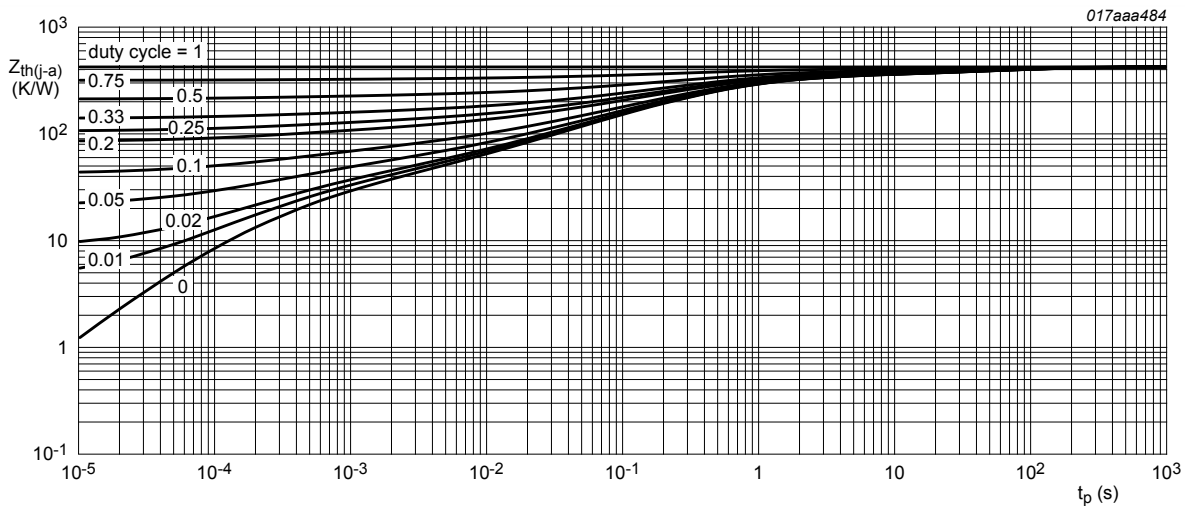
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[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>

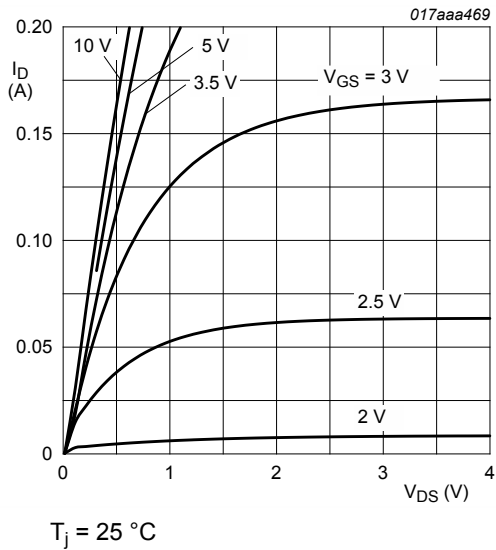
Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 7. Characteristics

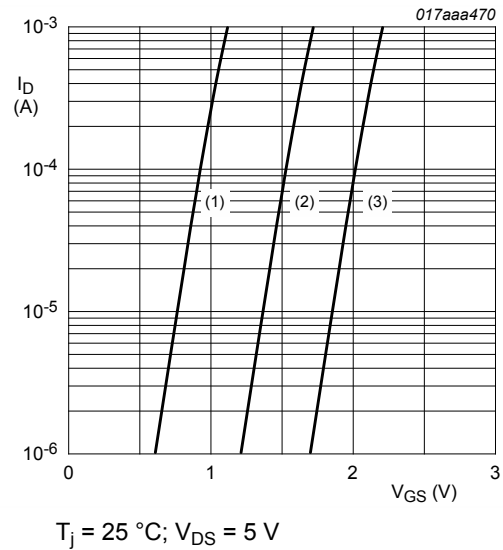
Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	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	$\mu A$
		$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 150 \text{ }^\circ C$	-	-	10	$\mu A$

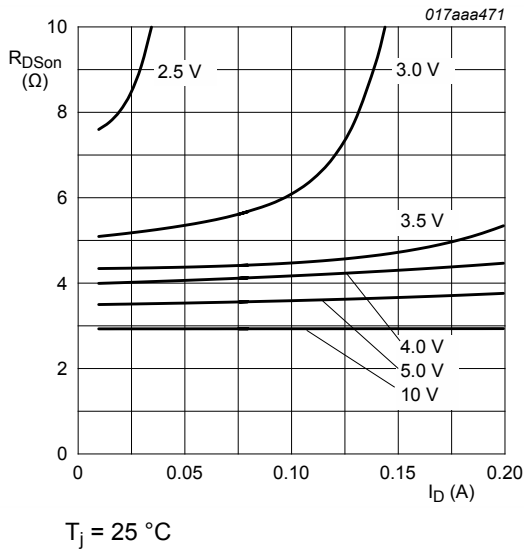
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	-	2	μA
		V <sub>GS</sub> = -20 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	-	2	μA
		V <sub>GS</sub> = 10 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	-	0.5	μA
		V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	-	0.5	μA
		V <sub>GS</sub> = 5 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	-	100	nA
		V <sub>GS</sub> = -5 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	-	100	nA
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 100 mA; T <sub>j</sub> = 25 °C	-	3	4.5	Ω
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 100 mA; T <sub>j</sub> = 150 °C	-	6.2	9.2	Ω
		V <sub>GS</sub> = 5 V; I <sub>D</sub> = 100 mA; T <sub>j</sub> = 25 °C	-	3.7	5.2	Ω
g <sub>fs</sub>	forward transconductance	V <sub>DS</sub> = 10 V; I <sub>D</sub> = 200 mA; T <sub>j</sub> = 25 °C	-	230	-	mS
<b>Dynamic characteristics</b>						
Q <sub>G(tot)</sub>	total gate charge	V <sub>DS</sub> = 30 V; I <sub>D</sub> = 200 mA; V <sub>GS</sub> = 4.5 V; T <sub>j</sub> = 25 °C	-	0.33	0.43	nC
Q <sub>GS</sub>	gate-source charge		-	0.12	-	nC
Q <sub>GD</sub>	gate-drain charge		-	0.09	-	nC
C <sub>iSS</sub>	input capacitance	V <sub>DS</sub> = 10 V; f = 1 MHz; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	11	17	pF
C <sub>oSS</sub>	output capacitance		-	3.4	-	pF
C <sub>rSS</sub>	reverse transfer capacitance		-	1.4	-	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 40 V; R <sub>L</sub> = 250 Ω; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 6 Ω; T <sub>j</sub> = 25 °C	-	6	12	ns
t <sub>r</sub>	rise time		-	7	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	20	40	ns
t <sub>f</sub>	fall time		-	14	-	ns
<b>Source-drain diode</b>						
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 115 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C	0.47	0.7	1.2	V



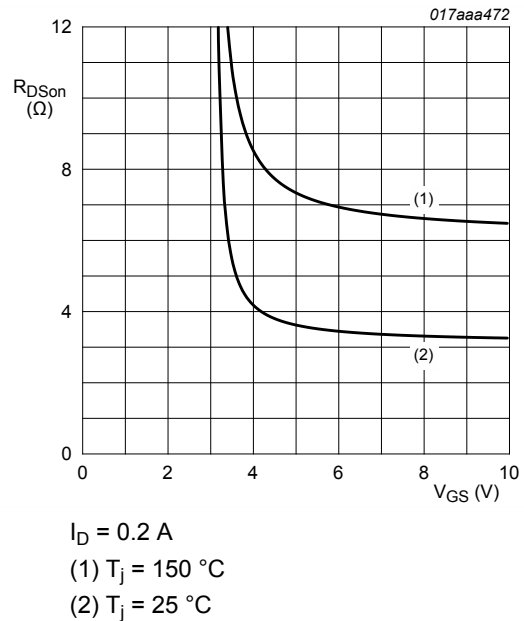
**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



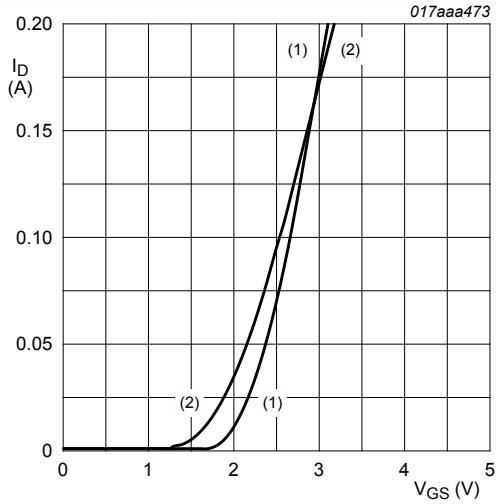
**Fig. 7. Sub-threshold drain current as a function of gate-source voltage**  
 (1) minimum values  
 (2) typical values  
 (3) maximum values



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

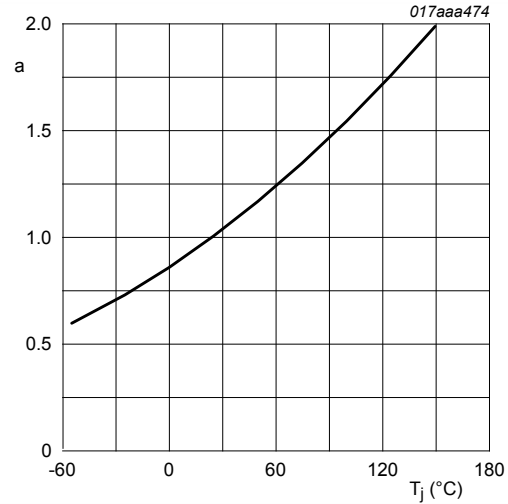


**Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values**



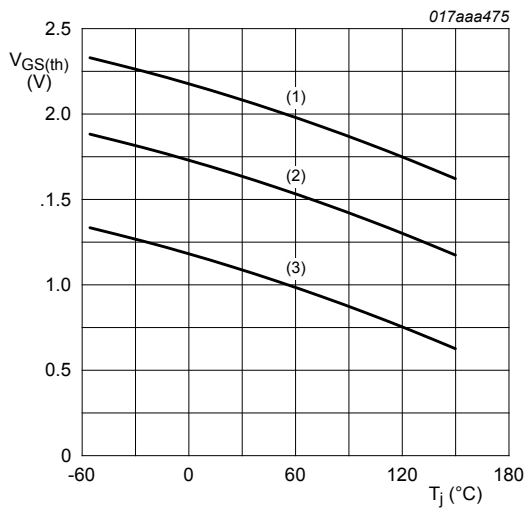
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25\text{ °C}$   
 (2)  $T_j = 150\text{ °C}$

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



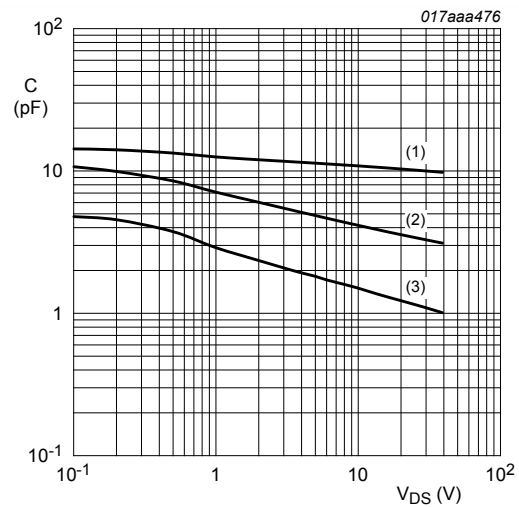
**Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values**

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



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

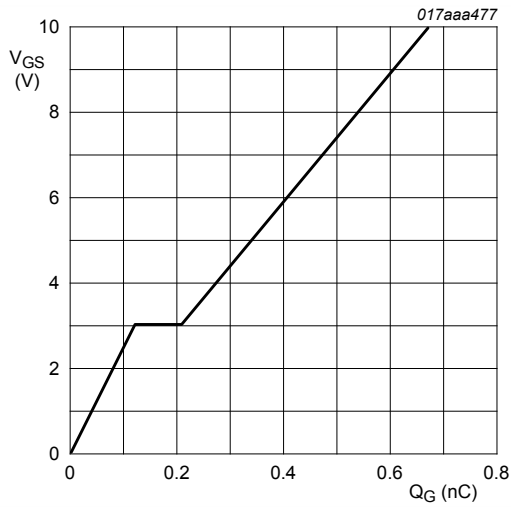
**Fig. 12. Gate-source threshold voltage as a function of junction temperature**



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

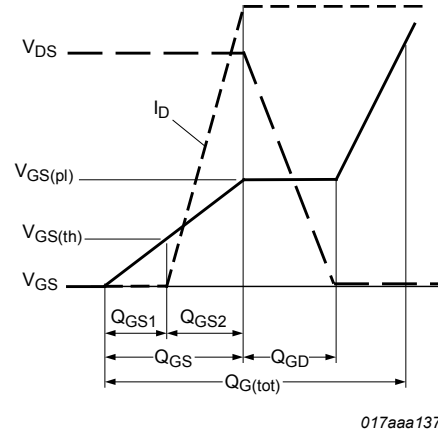
**Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



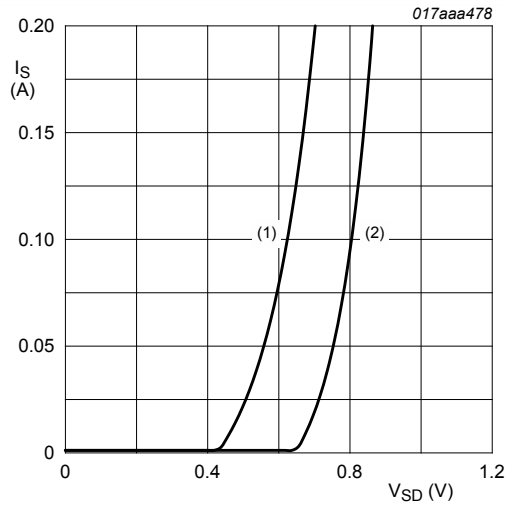


$I_D = 0.2 \text{ A}; V_{DS} = 30 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

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



**Fig. 15. 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

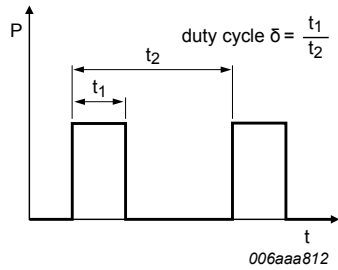


Fig. 17. Duty cycle definition

### 9. Package outline

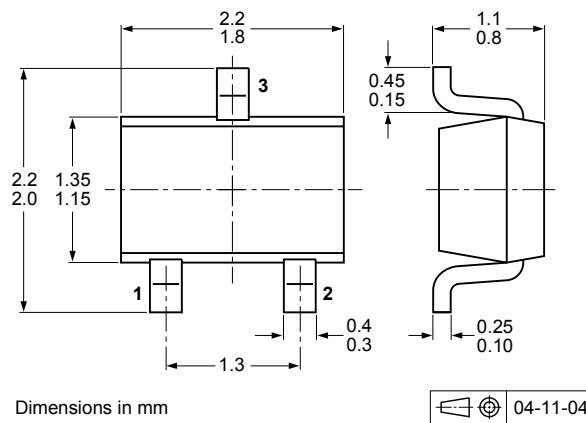


Fig. 18. SC-70 (SOT323)

### 10. Soldering

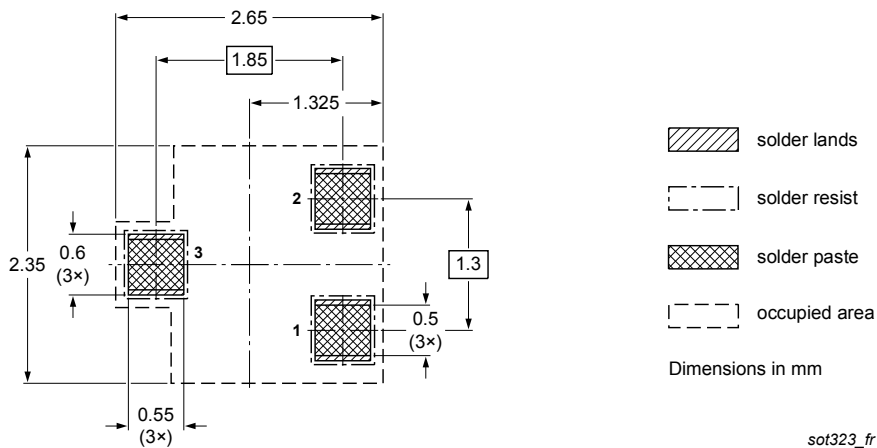


Fig. 19. Reflow soldering footprint for SOT323 (SC-70)

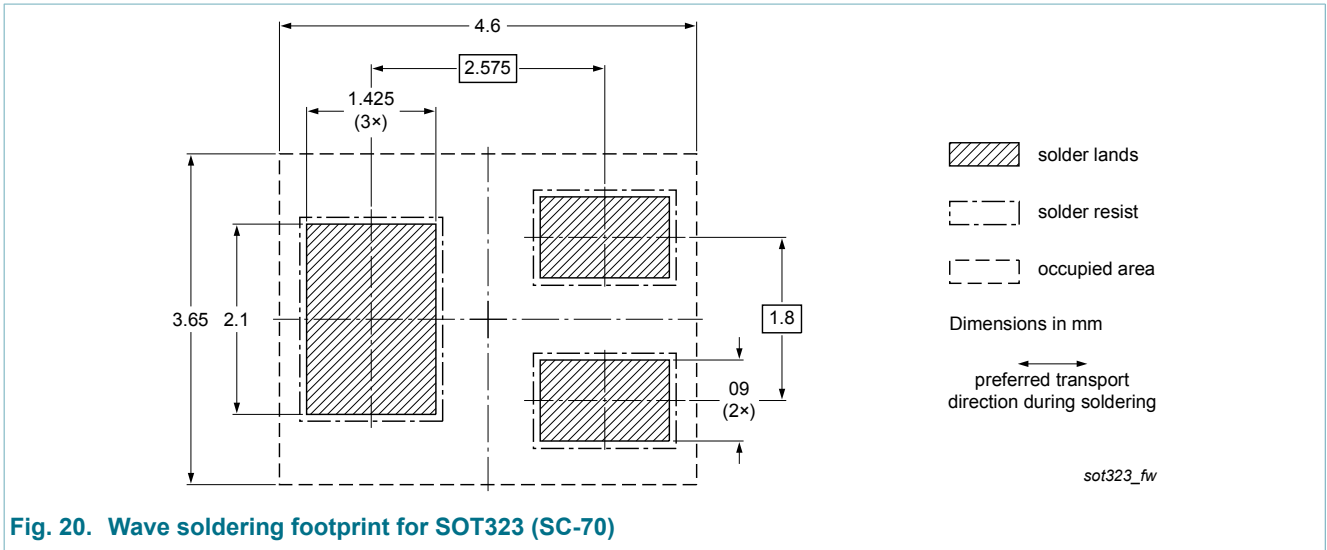


Fig. 20. Wave soldering footprint for SOT323 (SC-70)

## 11. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NX7002AKW v.2	20120711	Product data sheet	-	NX7002AKW v.1
Modifications:	<ul style="list-style-type: none"> <li>Characteristics: <math>I_{GSS}</math> value corrected</li> </ul>			
NX7002AKW v.1	20120301	Product data sheet	-	-

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### 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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Date of release: 11 July 2012

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