

# NX3008CBKV

30 / 30 V, 400 / 220 mA N/P-channel Trench MOSFET

Rev. 1 — 29 July 2011

Product data sheet

## 1. Product profile

### 1.1 General description

Complementary N/P-channel enhancement mode Field-Effect Transistor (FET) in an ultra small and flat lead SOT666 Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

### 1.2 Features and benefits

- Low threshold voltage
- Very fast switching
- Trench MOSFET technology
- ESD protection up to 2 kV
- AEC-Q101 qualified

### 1.3 Applications

- Level shifter
- Power supply converter
- Load switch
- Switching circuits

### 1.4 Quick reference data

Table 1. Quick reference data

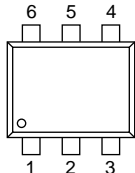
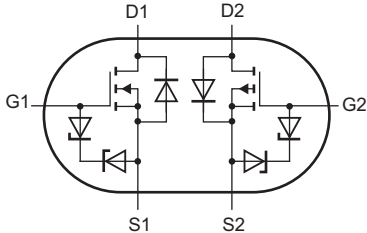
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR2 (P-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	-30	V
$V_{GS}$	gate-source voltage		-8	-	8	V
$I_D$	drain current	$V_{GS} = -4.5\text{ V}; T_{amb} = 25\text{ °C}$	[1] -	-	-220	mA
<b>TR1 (N-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	30	V
$V_{GS}$	gate-source voltage		-8	-	8	V
$I_D$	drain current	$V_{GS} = 4.5\text{ V}; T_{amb} = 25\text{ °C}$	[1] -	-	400	mA
<b>TR1 (N-channel), Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}; I_D = 350\text{ mA}; T_j = 25\text{ °C}$	-	1	1.4	$\Omega$
<b>TR2 (P-channel), Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = -4.5\text{ V}; I_D = -200\text{ mA}; T_j = 25\text{ °C}$	-	2.8	4.1	$\Omega$

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and 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><b>SOT666 (SOT666)</b></p>	 <p>017aaa262</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		Version
	Name	Description	
NX3008CBKV	SOT666	plastic surface-mounted package; 6 leads	SOT666

## 4. Marking

**Table 4. Marking codes**

Type number	Marking code <sup>[1]</sup>
NX3008CBKV	AC

[1] % = placeholder for manufacturing site code.

## 5. Limiting values

**Table 5. Limiting values**

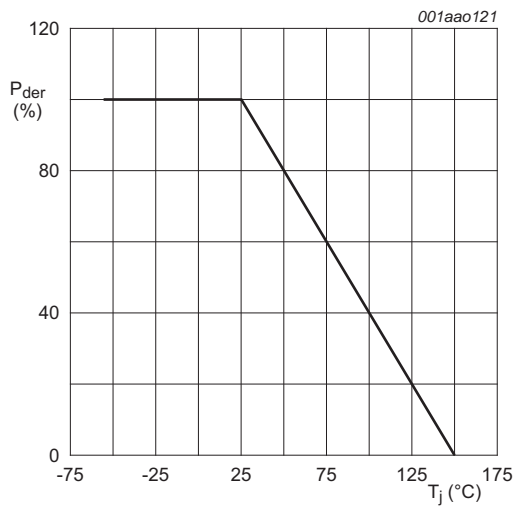
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit	
<b>TR2 (P-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-30	V	
$V_{GS}$	gate-source voltage		-8	8	V	
$I_D$	drain current	$V_{GS} = -4.5\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	-220	mA
		$V_{GS} = -4.5\text{ V}; T_{amb} = 100\text{ °C}$	[1]	-	-140	mA
$I_{DM}$	peak drain current	$T_{amb} = 25\text{ °C};$ single pulse; $t_p \leq 10\text{ }\mu\text{s}$	-	-0.9	A	
$P_{tot}$	total power dissipation	$T_{amb} = 25\text{ °C}$	[2]	-	330	mW
			[1]	-	390	mW
		$T_{sp} = 25\text{ °C}$	-	-	1090	mW
<b>TR1 (N-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	30	V	
$V_{GS}$	gate-source voltage		-8	8	V	
$I_D$	drain current	$V_{GS} = 4.5\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	400	mA
		$V_{GS} = 4.5\text{ V}; T_{amb} = 100\text{ °C}$	[1]	-	260	mA
$I_{DM}$	peak drain current	$T_{amb} = 25\text{ °C};$ single pulse; $t_p \leq 10\text{ }\mu\text{s}$	-	1.6	A	
$P_{tot}$	total power dissipation	$T_{amb} = 25\text{ °C}$	[2]	-	330	mW
			[1]	-	390	mW
		$T_{sp} = 25\text{ °C}$	-	-	1090	mW
<b>Per device</b>						
$P_{tot}$	total power dissipation	$T_{amb} = 25\text{ °C}$	[2]	-	500	mW
$T_j$	junction temperature		-55	150	°C	
$T_{amb}$	ambient temperature		-55	150	°C	
$T_{stg}$	storage temperature		-65	150	°C	
<b>TR1 (N-channel), Source-drain diode</b>						
$I_S$	source current	$T_{amb} = 25\text{ °C}$	[1]	-	400	mA
<b>TR2 (P-channel), Source-drain diode</b>						
$I_S$	source current	$T_{amb} = 25\text{ °C}$	[1]	-	-220	mA
<b>TR1 N-channel), ESD maximum rating</b>						
$V_{ESD}$	electrostatic discharge voltage	HBM	[3]	-	2000	V
<b>TR2 (P-channel), ESD maximum rating</b>						
$V_{ESD}$	electrostatic discharge voltage	HBM	[3]	-	2000	V

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

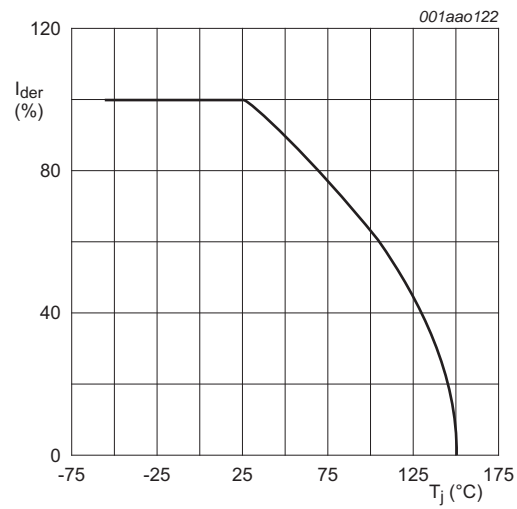
[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper; tin-plated and standard footprint.

[3] Measured between all pins.



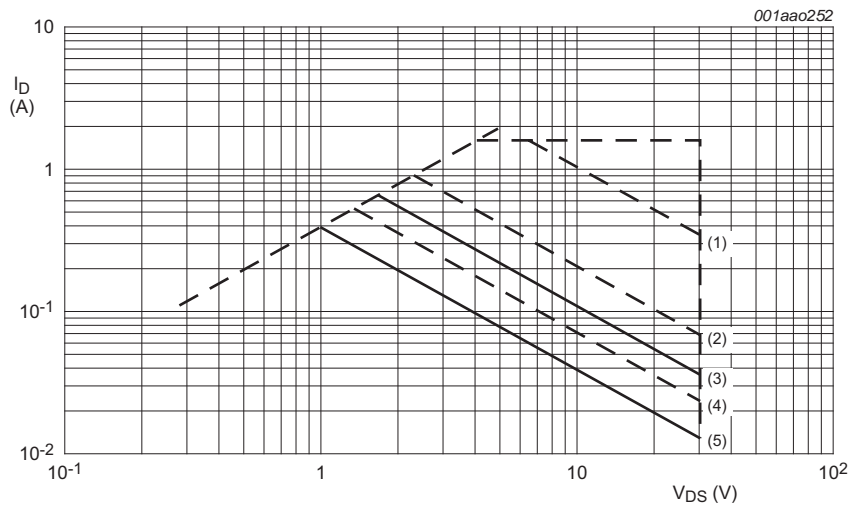
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



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

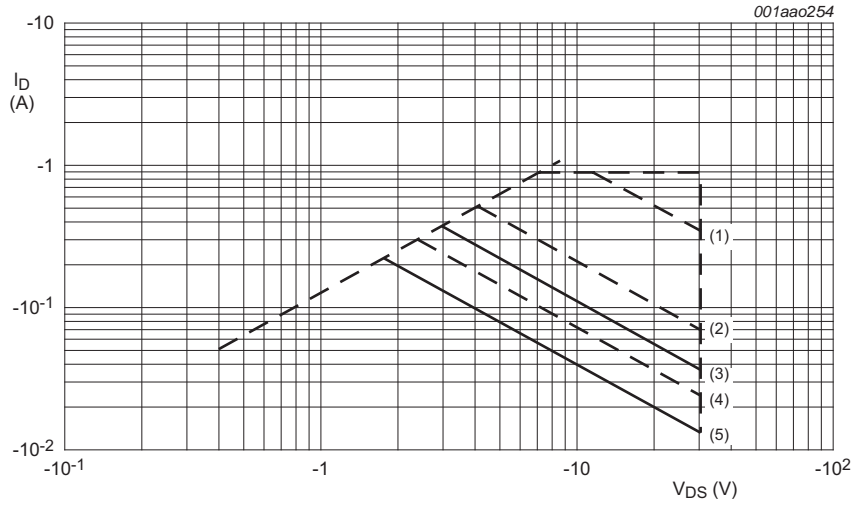
**Fig 2. Normalized continuous drain current as a function of junction temperature**



$I_{DM}$  is a 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;  $T_{amb} = 25^{\circ}C$ ;  $1 \text{ cm}^2$  drain mounting pad

**Fig 3. Safe operating area TR1 (N-channel); junction to ambient; continuous and peak drain currents as a function of drain-source voltage**



$I_{DM}$  is a single pulse

(1)  $t_p = 1 \text{ ms}$

(2)  $t_p = 10 \text{ ms}$

(3) DC;  $T_{sp} = 25 \text{ °C}$

(4)  $t_p = 100 \text{ ms}$

(5) DC;  $T_{amb} = 25 \text{ °C}$ ;  $1 \text{ cm}^2$  drain mounting pad

Fig 4. Safe operating area TR2 (P-channel); 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	Typ	Max	Unit
<b>Per device</b>						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	250 K/W
<b>TR1 (N-channel)</b>						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	330	380 K/W
			[2]	-	280	320 K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	115	K/W
<b>TR2 (P-channel)</b>						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	330	380 K/W
			[2]	-	280	320 K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	-	115	K/W

[1] Device mounted on an FR4 Printed-Circuit Board (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  $1 \text{ cm}^2$ .

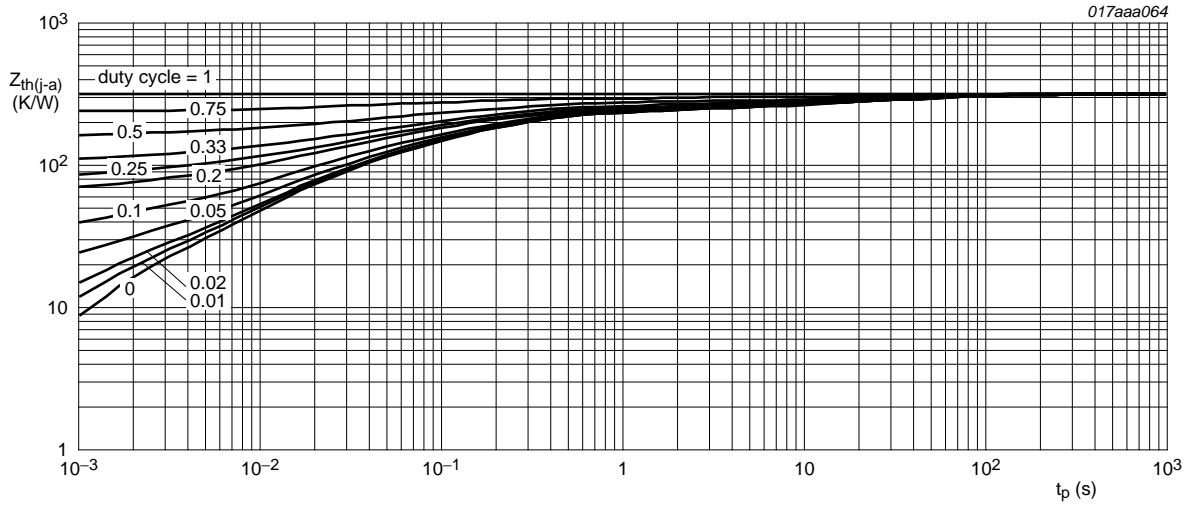


Fig 5. TR1: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

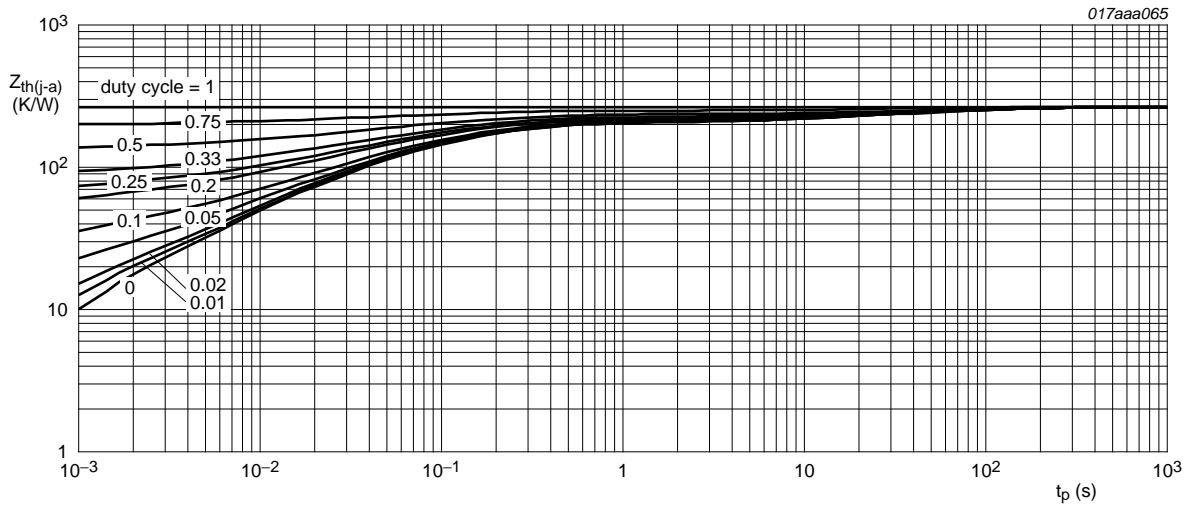


Fig 6. TR1: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

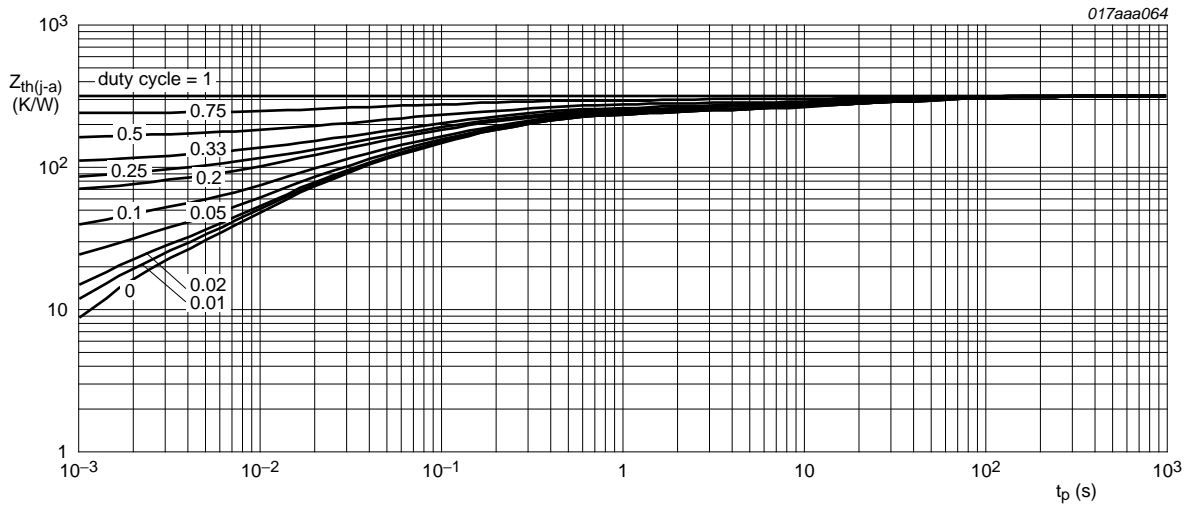


Fig 7. TR2, Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

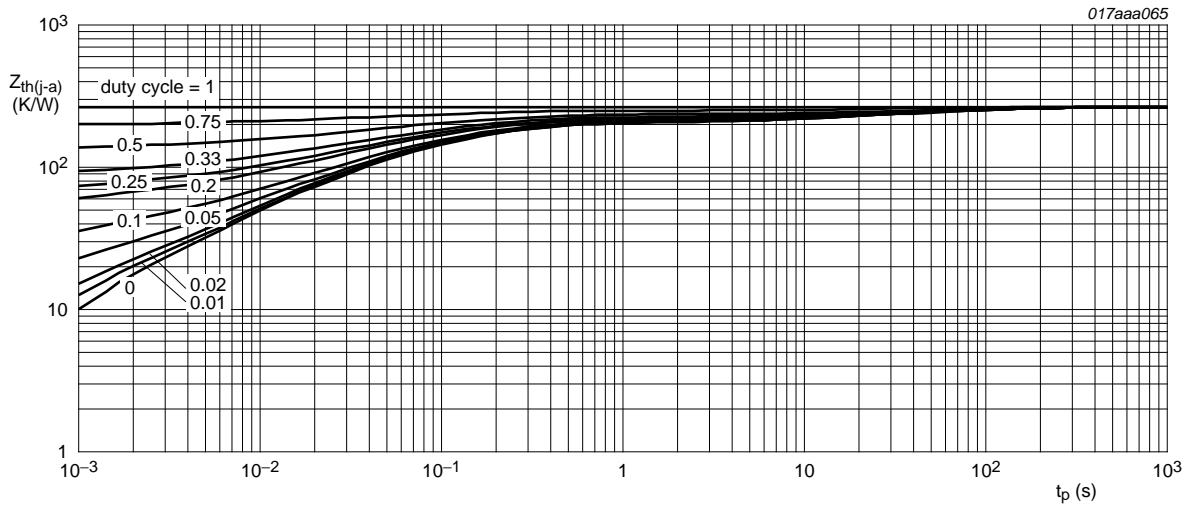


Fig 8. TR2, Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 7. Characteristics

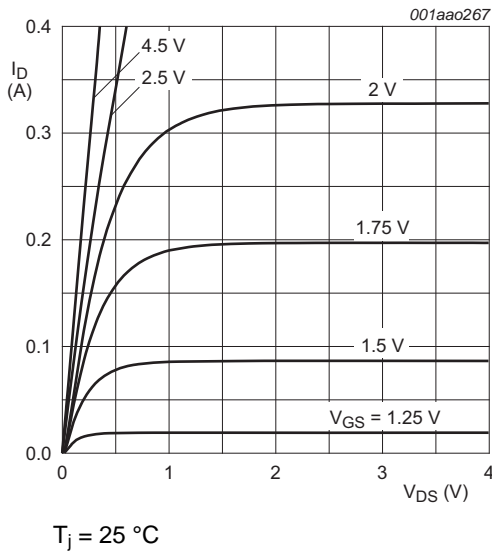
**Table 7. Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR2 (P-channel), Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = -250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-30	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = -250 \mu A; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	-0.6	-0.9	-1.1	V
$I_{DSS}$	drain leakage current	$V_{DS} = -30 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	-1	$\mu A$
		$V_{DS} = -30 V; V_{GS} = 0 V; T_j = 150 \text{ }^\circ C$	-	-	-10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 8 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-0.2	-1	$\mu A$
		$V_{GS} = -8 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-0.2	-1	$\mu A$
		$V_{GS} = 4.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-10	-	nA
		$V_{GS} = -4.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-10	-	nA
		$V_{GS} = 2.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-1	-	nA
		$V_{GS} = -2.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-1	-	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = -4.5 V; I_D = -200 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	2.8	4.1	$\Omega$
		$V_{GS} = -2.5 V; I_D = -10 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	5.3	6.5	$\Omega$
		$V_{GS} = -4.5 V; I_D = -200 \text{ mA}; T_j = 150 \text{ }^\circ C$	-	5.3	7.8	$\Omega$
$g_{fs}$	transfer conductance	$V_{DS} = -10 V; I_D = -200 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	160	-	mS
<b>TR1 (N-channel), Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	30	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu A; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	0.6	0.9	1.1	V
$I_{DSS}$	drain leakage current	$V_{DS} = 30 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	1	$\mu A$
		$V_{DS} = 30 V; V_{GS} = 0 V; T_j = 150 \text{ }^\circ C$	-	-	10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 8 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	0.2	1	$\mu A$
		$V_{GS} = -8 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	0.2	1	$\mu A$
		$V_{GS} = 4.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	10	-	nA
		$V_{GS} = -4.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	10	-	nA
		$V_{GS} = 2.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	1	-	nA
		$V_{GS} = -2.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	1	-	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5 V; I_D = 350 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	1	1.4	$\Omega$
		$V_{GS} = 4.5 V; I_D = 350 \text{ mA}; T_j = 150 \text{ }^\circ C$	-	1.8	2.5	$\Omega$
		$V_{GS} = 2.5 V; I_D = 200 \text{ mA}; T_j = 150 \text{ }^\circ C$	-	1.4	2.1	$\Omega$
		$V_{GS} = 1.8 V; I_D = 10 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	2	2.8	$\Omega$
$g_{fs}$	transfer conductance	$V_{DS} = 10 V; I_D = 350 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	310	-	mS
<b>TR1 (N-channel), Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 15 V; I_D = 400 \text{ mA}; V_{GS} = 4.5 V; T_j = 25 \text{ }^\circ C$	-	0.52	0.68	nC
$Q_{GS}$	gate-source charge		-	0.17	-	nC
$Q_{GD}$	gate-drain charge		-	0.08	-	nC

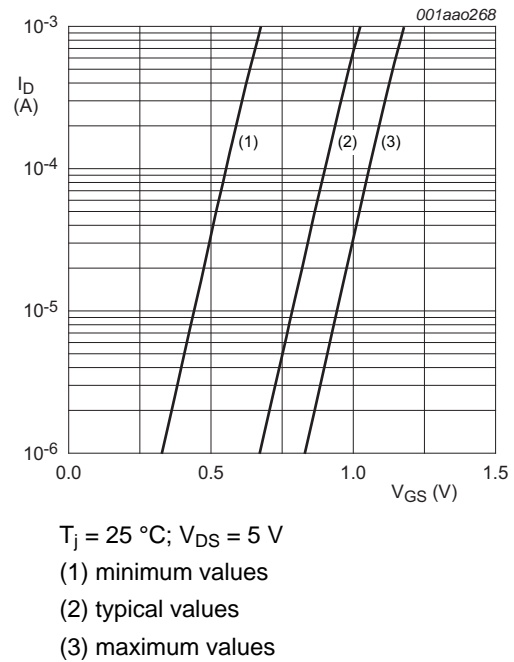


Table 7. Characteristics ...continued

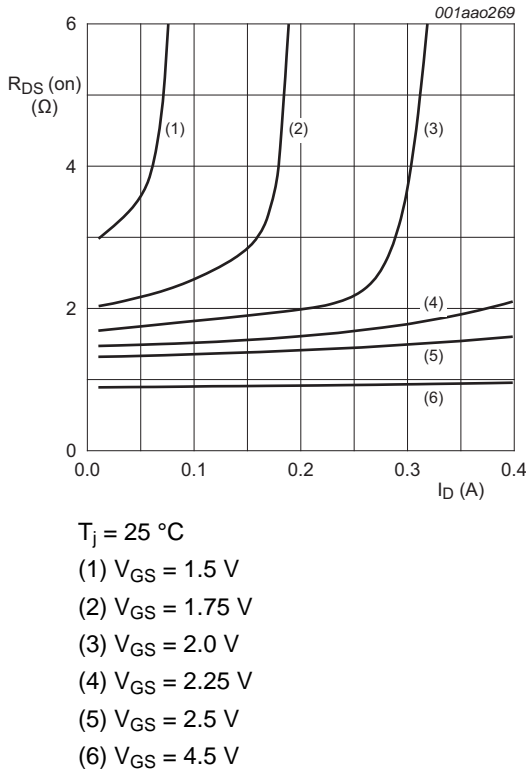
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{iss}$	input capacitance	$V_{DS} = 15\text{ V}; f = 1\text{ MHz}; V_{GS} = 0\text{ V};$ $T_j = 25\text{ °C}$	-	34	50	pF
$C_{oss}$	output capacitance		-	6.5	-	pF
$C_{rss}$	reverse transfer capacitance		-	2.2	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20\text{ V}; R_L = 250\text{ }\Omega; V_{GS} = 4.5\text{ V};$ $R_{G(ext)} = 6\text{ }\Omega; T_j = 25\text{ °C}$	-	15	30	ns
$t_r$	rise time		-	11	-	ns
$t_{d(off)}$	turn-off delay time		-	69	138	ns
$t_f$	fall time		-	19	-	ns
<b>TR2 (P-channel), Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = -15\text{ V}; I_D = -200\text{ mA};$ $V_{GS} = -4.5\text{ V}; T_j = 25\text{ °C}$	-	0.55	0.72	nC
$Q_{GS}$	gate-source charge		-	0.23	-	nC
$Q_{GD}$	gate-drain charge		-	0.09	-	nC
$C_{iss}$	input capacitance	$V_{DS} = -15\text{ V}; f = 1\text{ MHz}; V_{GS} = 0\text{ V};$ $T_j = 25\text{ °C}$	-	31	46	pF
$C_{oss}$	output capacitance		-	6.5	-	pF
$C_{rss}$	reverse transfer capacitance		-	2.3	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = -20\text{ V}; R_L = 250\text{ }\Omega; V_{GS} = -4.5\text{ V};$ $R_{G(ext)} = 6\text{ }\Omega; T_j = 25\text{ °C}$	-	19	38	ns
$t_r$	rise time		-	30	-	ns
$t_{d(off)}$	turn-off delay time		-	65	130	ns
$t_f$	fall time		-	38	-	ns
<b>TR2 (P-channel), Source-drain diode characteristics</b>						
$V_{SD}$	source-drain voltage	$I_S = -200\text{ mA}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C}$	-0.47	-0.88	-1.2	V
<b>TR1 (N-channel), Source-drain diode characteristics</b>						
$V_{SD}$	source-drain voltage	$I_S = 350\text{ mA}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C}$	0.47	0.85	1.2	V



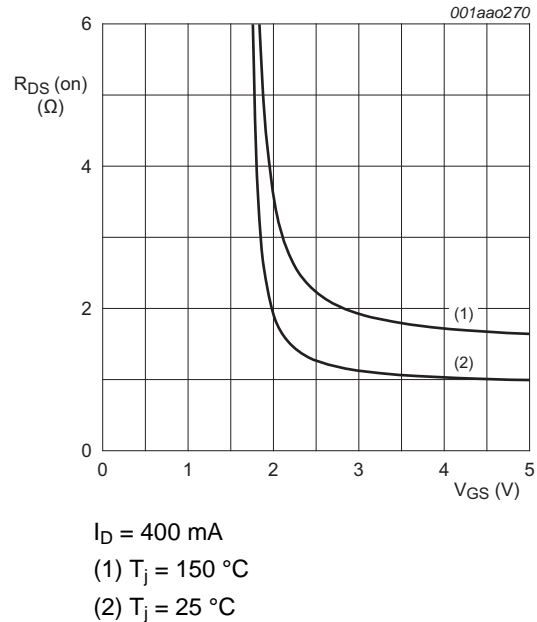
**Fig 9. TR1: Output characteristics: drain current as a function of drain-source voltage; typical values**



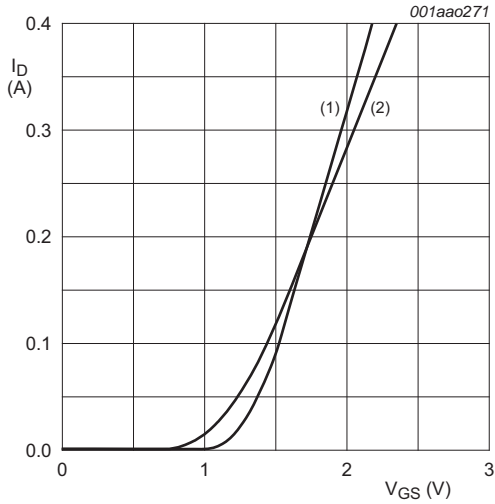
**Fig 10. TR1: Sub-threshold drain current as a function of gate-source voltage**



**Fig 11. TR1: Drain-source on-state resistance as a function of drain current; typical values**

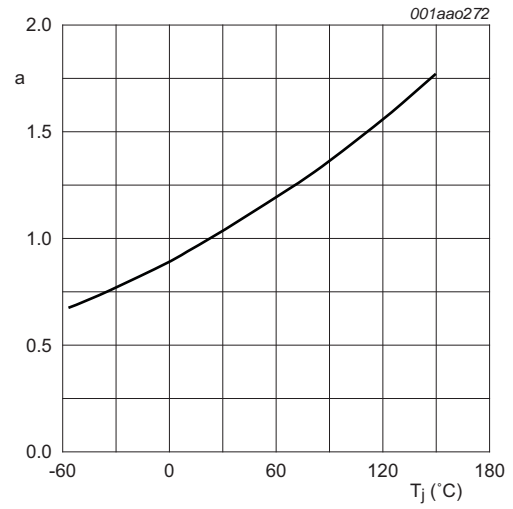


**Fig 12. TR1: Drain-source on-state resistance as a function of gate-source voltage; typical values**



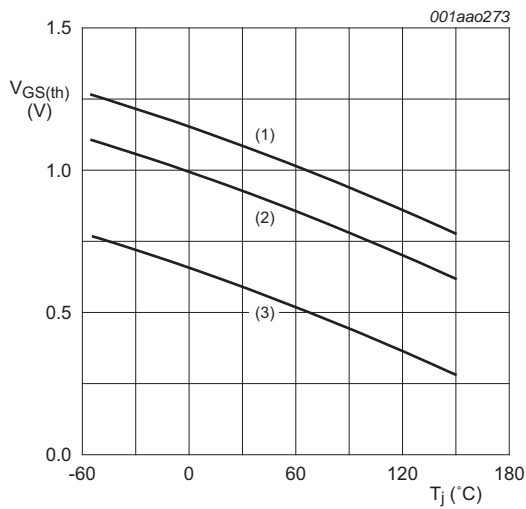
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25\text{ °C}$   
 (2)  $T_j = 150\text{ °C}$

**Fig 13. TR1: Transfer characteristics: drain current as a function of gate-source voltage; typical values**



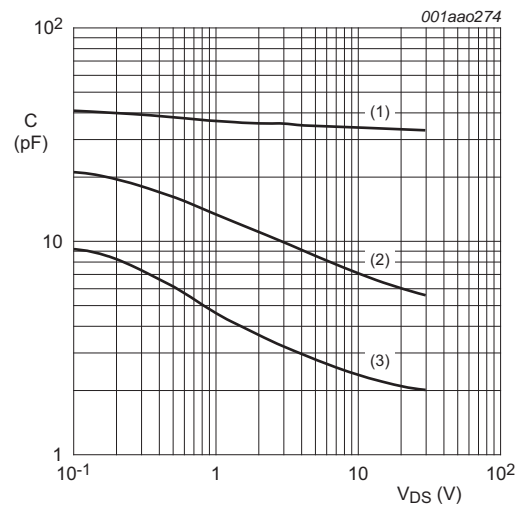
$$a = \frac{R_{DS(on)}}{R_{DS(on)@25^\circ\text{C}}}$$

**Fig 14. TR1: Normalized drain-source on-state resistance as a function of junction temperature; typical values**



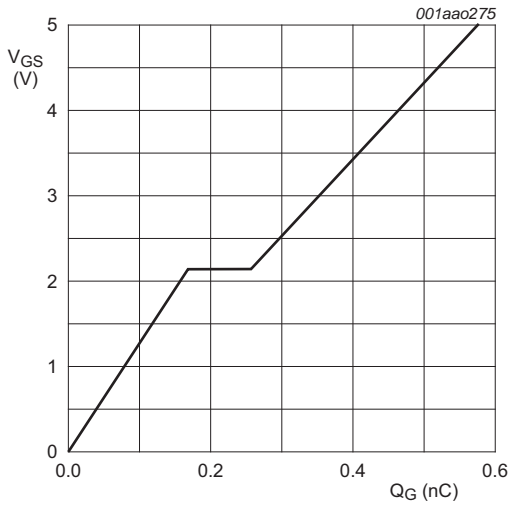
$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$   
 (1) maximum values  
 (2) typical values  
 (3) minimum values

**Fig 15. TR1: Gate-source threshold voltage as a function of junction temperature**



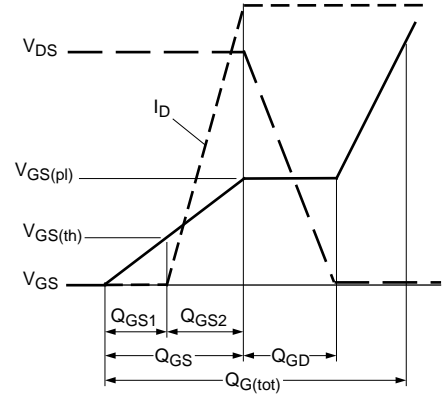
$f = 1\text{ MHz}; V_{GS} = 0\text{ V}$   
 (1)  $C_{iss}$   
 (2)  $C_{oss}$   
 (3)  $C_{rss}$

**Fig 16. TR1: Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

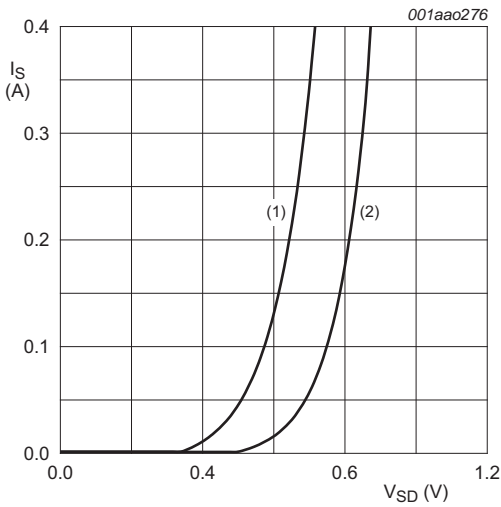


$I_D = 0.4$  A;  $V_{DS} = 15$  V;  $T_{amb} = 25$  °C

**Fig 17. TR1: Gate-source voltage as a function of gate charge; typical values**

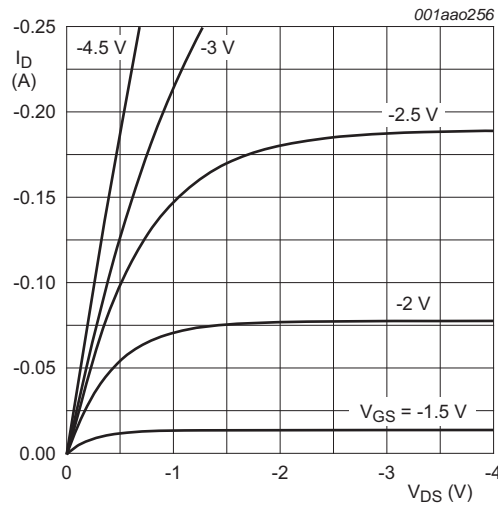


**Fig 18. Gate charge waveform definitions**



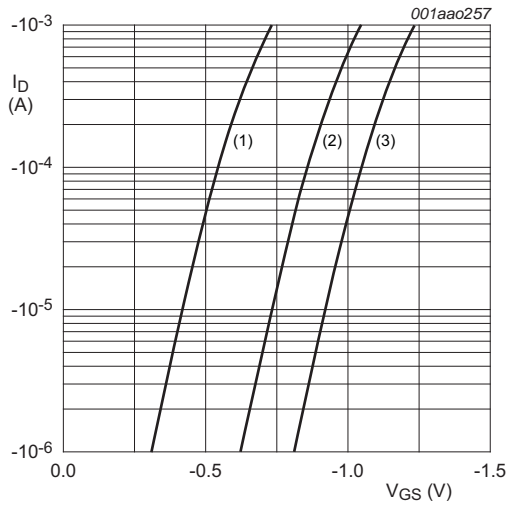
$V_{GS} = 0$  V  
 (1)  $T_j = 150$  °C  
 (2)  $T_j = 25$  °C

**Fig 19. TR1: Source current as a function of source-drain voltage; typical values**



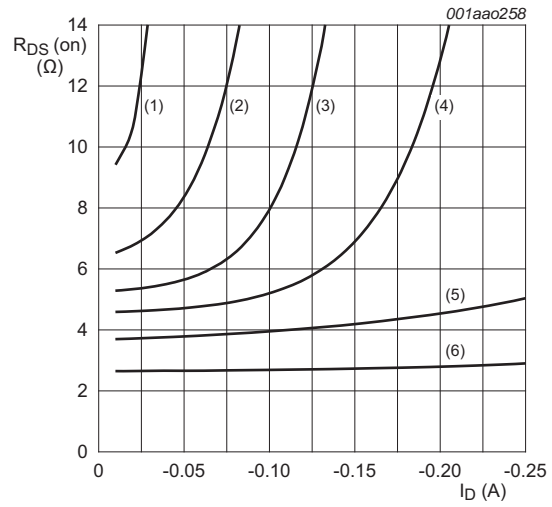
$T_j = 25$  °C

**Fig 20. TR2: Output characteristics: drain current as a function of drain-source voltage; typical values**



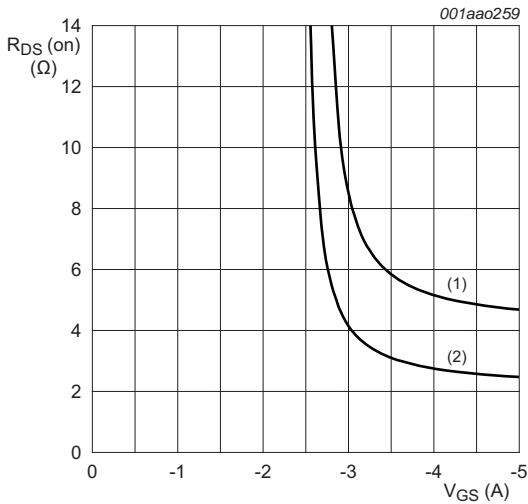
$T_j = 25\text{ }^\circ\text{C}; V_{DS} = -5\text{ V}$   
 (1) minimum values  
 (2) typical values  
 (3) maximum values

**Fig 21. TR2: Sub-threshold drain current as a function of gate-source voltage**



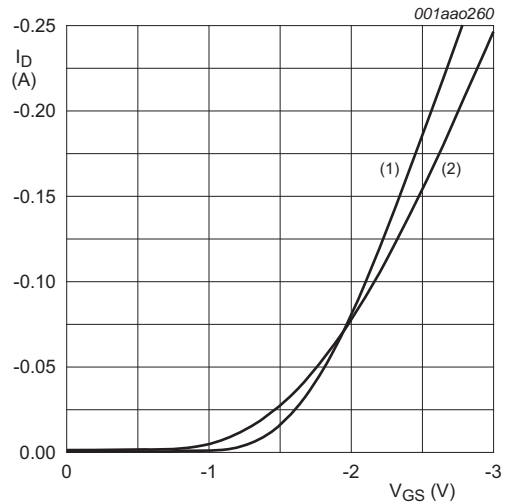
$T_j = 25\text{ }^\circ\text{C}$   
 (1)  $V_{GS} = -1.75\text{ V}$   
 (2)  $V_{GS} = -2.0\text{ V}$   
 (3)  $V_{GS} = -2.25\text{ V}$   
 (4)  $V_{GS} = -2.5\text{ V}$   
 (5)  $V_{GS} = -3.0\text{ V}$   
 (6)  $V_{GS} = -4.5\text{ V}$

**Fig 22. TR2: Drain-source on-state resistance as a function of drain current; typical values**



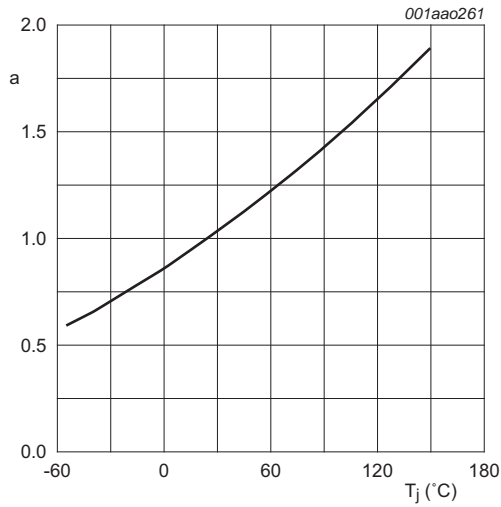
$I_D = -200\text{ mA}$   
 (1)  $T_j = 150\text{ }^\circ\text{C}$   
 (2)  $T_j = 25\text{ }^\circ\text{C}$

**Fig 23. TR2: Drain-source on-state resistance as a function of gate-source voltage; typical values**



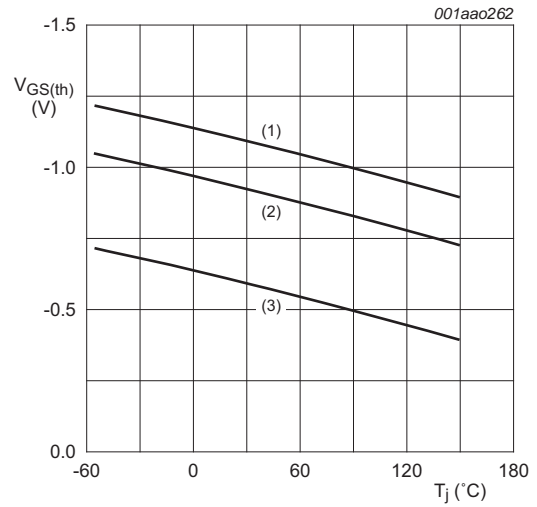
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25\text{ }^\circ\text{C}$   
 (2)  $T_j = 150\text{ }^\circ\text{C}$

**Fig 24. TR2: Transfer characteristics: drain current as a function of gate-source voltage; typical values**



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

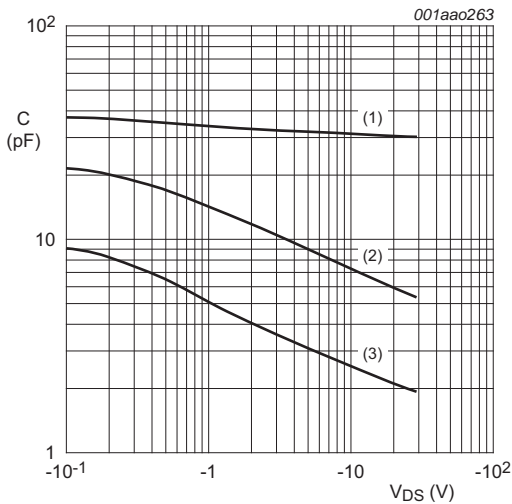
Fig 25. TR2: Normalized drain-source on-state resistance as a function of junction temperature; typical values



I<sub>D</sub> = -0.25 mA; V<sub>DS</sub> = V<sub>GS</sub>

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

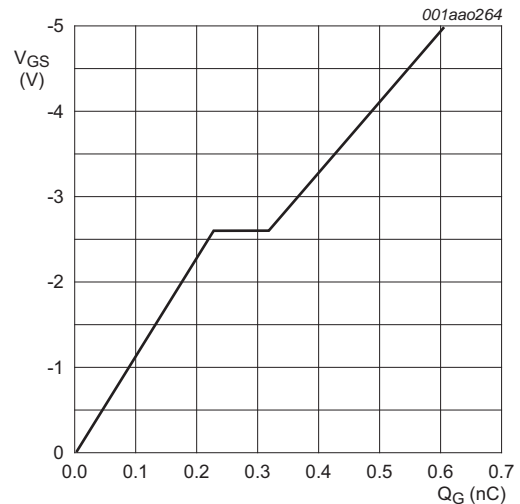
Fig 26. TR2: Gate-source threshold voltage as a function of junction temperature



f = 1 MHz; V<sub>GS</sub> = 0 V

- (1) C<sub>iss</sub>
- (2) C<sub>oss</sub>
- (3) C<sub>rss</sub>

Fig 27. TR2: Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



I<sub>D</sub> = -200 mA; V<sub>DS</sub> = -15 V; T<sub>amb</sub> = 25 °C

Fig 28. Gate-source voltage as a function of gate charge; typical values

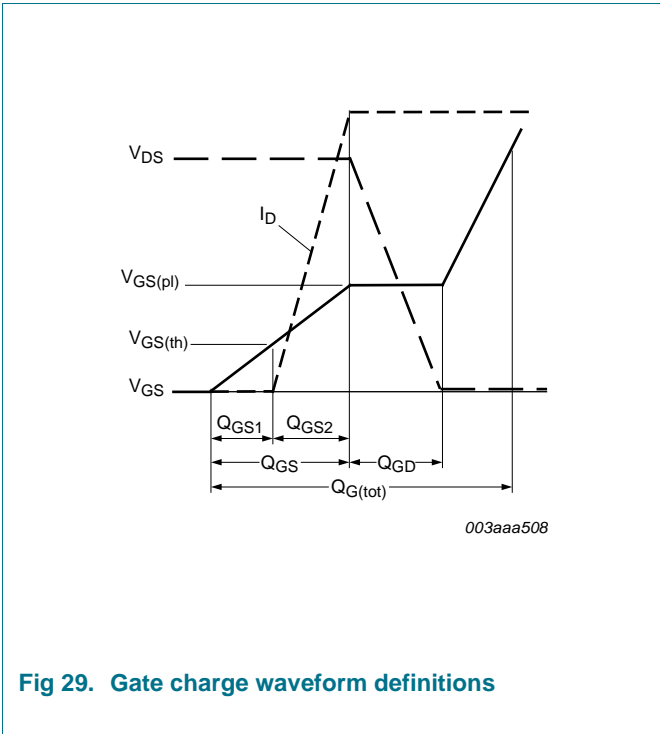


Fig 29. Gate charge waveform definitions

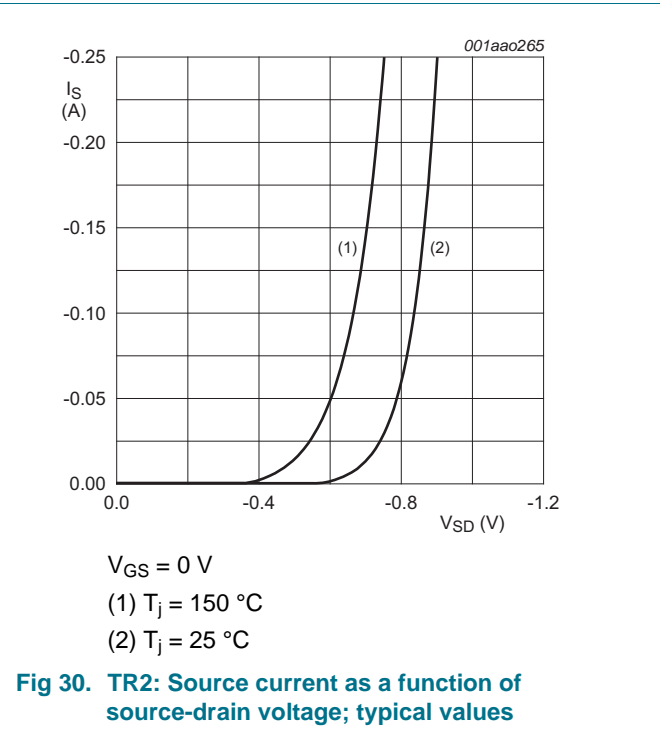


Fig 30. TR2: Source current as a function of source-drain voltage; typical values

## 8. Test information

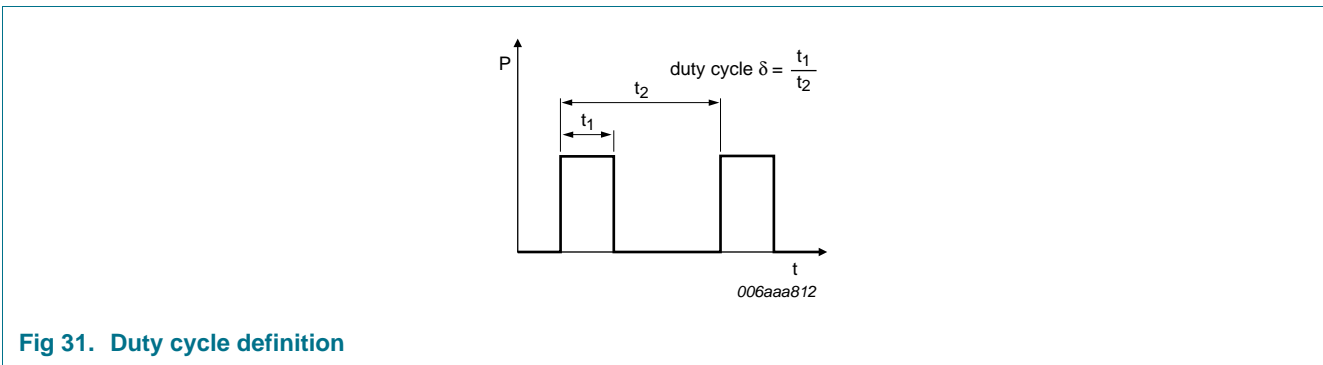


Fig 31. Duty cycle definition

### 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.

9. Package outline

Plastic surface-mounted package; 6 leads

SOT666

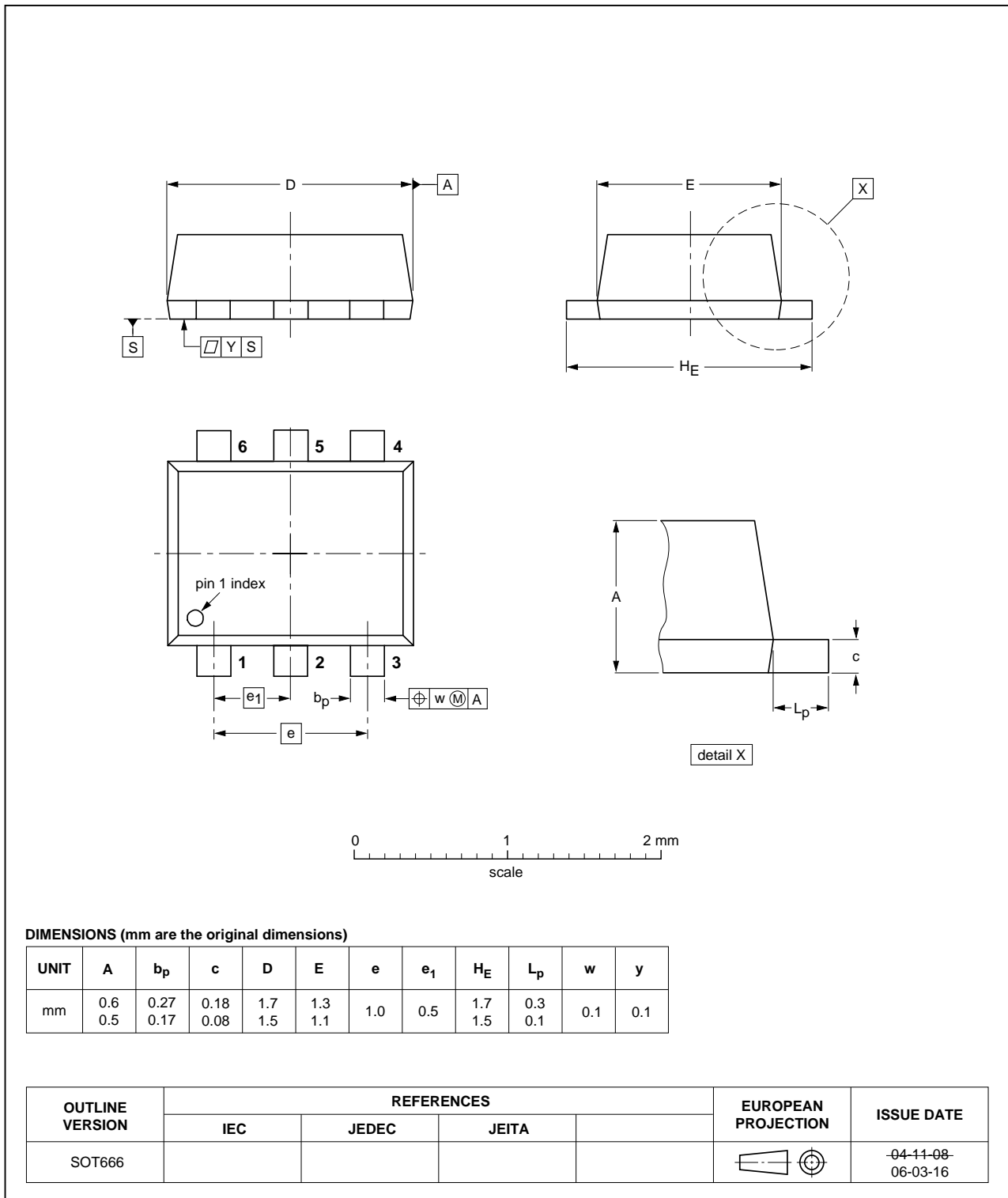
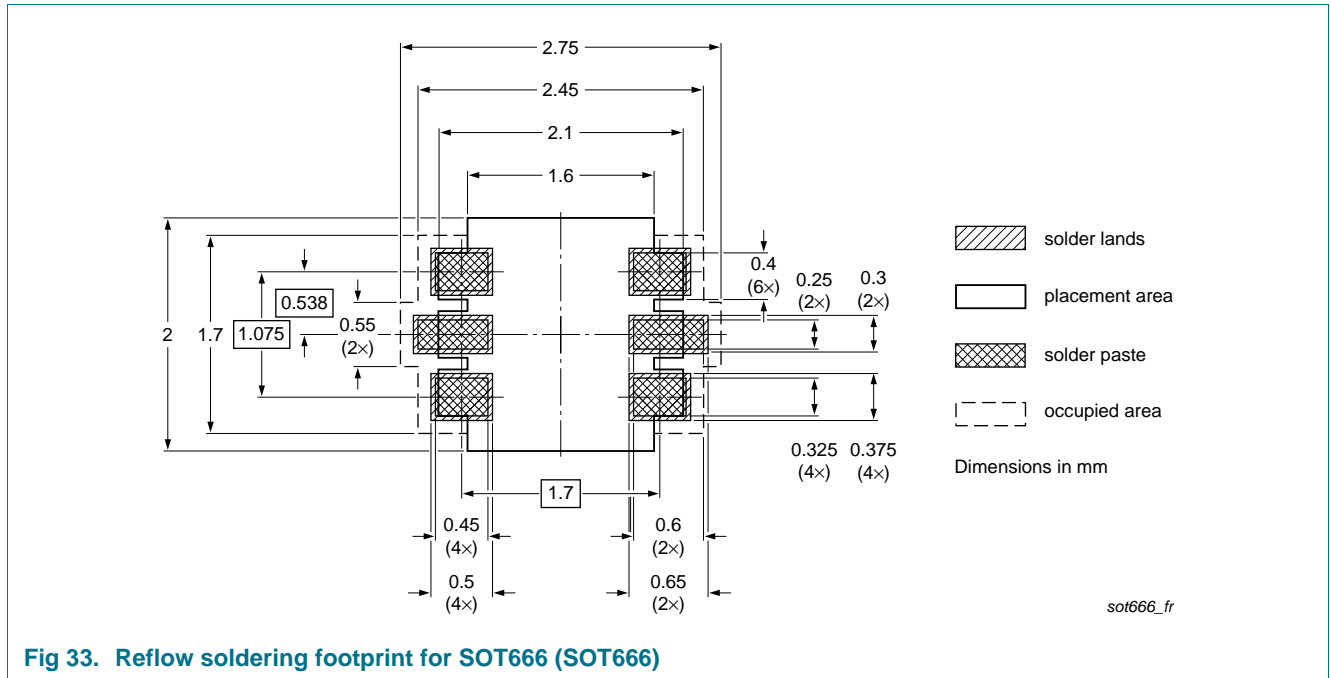


Fig 32. Package outline SOT666 (SOT666)



## 10. Soldering



**Fig 33. Reflow soldering footprint for SOT666 (SOT666)**

## 11. Revision history

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**Table 8.** Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX3008CBKV v.1	20110729	Product data sheet	-	-

## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1]</sup> <sup>[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.

[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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