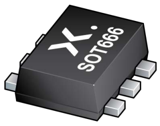
THE DATASHEET OF

NX1029X,115



NX1029X

60 / 50 V, 330 / 170 mA N/P-channel Trench MOSFET

Rev. 1 — 12 August 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

- Logic-level compatible
- Very fast switching
- Trench MOSFET technology
- ESD protection up to 2 kV (N-channel) and 1 kV (P-channel)
- AEC-Q101 qualified

1.3 Applications

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

1.4 Quick reference data

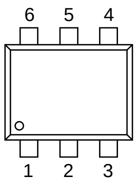
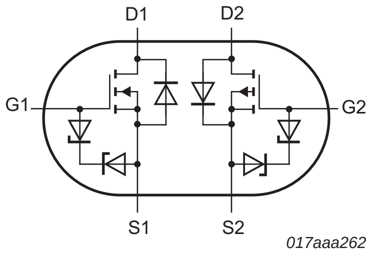
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
TR2 (P-channel)							
V_{DS}	drain-source voltage	T_j = 25 °C		-	-	-50	V
V_{GS}	gate-source voltage			-20	-	20	V
I_D	drain current	V_{GS} = -10 V; T_{amb} = 25 °C	[1]	-	-	-170	mA
TR1 (N-channel)							
V_{DS}	drain-source voltage	T_j = 25 °C		-	-	60	V
V_{GS}	gate-source voltage			-20	-	20	V
I_D	drain current	V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	-	330	mA
TR1 (N-channel), Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA; pulsed; t_p ≤ 300 µs; δ ≤ 0.01 ; T_j = 25 °C		-	1	1.6	Ω
TR2 (P-channel), Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = -10 V; I_D = -100 mA; T_j = 25 °C		-	4.5	7.5	Ω

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

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source TR1	 SOT666 (SOT666)	 017aaa262
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
NX1029X	SOT666	plastic surface-mounted package; 6 leads	SOT666

4. Marking

Table 4. Marking codes

Type number	Marking code[1]
NX1029X	AD

[1] % = placeholder for manufacturing site code.

5. Limiting values

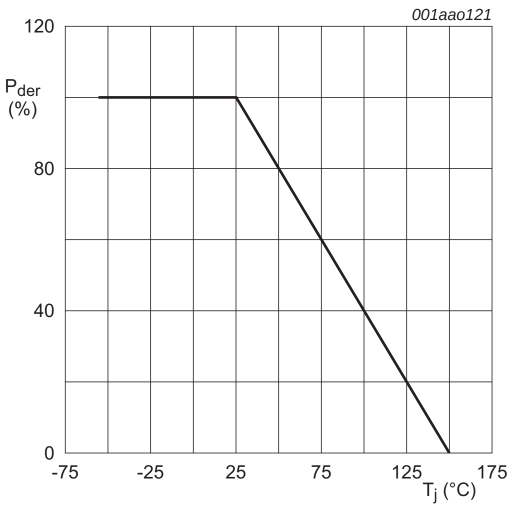
Table 5. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
TR2 (P-channel)						
V_{DS}	drain-source voltage	T_j = 25 °C		-	-50	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = -10 V; T_{amb} = 25 °C	[1]	-	-170	mA
		V_{GS} = -10 V; T_{amb} = 100 °C	[1]	-	-110	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq 10$ µs		-	-0.7	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	330	mW
			[1]	-	390	mW
		T_{sp} = 25 °C		-	1090	mW
TR1 (N-channel)						
V_{DS}	drain-source voltage	T_j = 25 °C		-	60	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	330	mA
		V_{GS} = 10 V; T_{amb} = 100 °C	[1]	-	210	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq 10$ µs		-	1.2	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	330	mW
			[1]	-	390	mW
		T_{sp} = 25 °C		-	1090	mW
Per device						
P_{tot}	total power dissipation	T_{amb} = 25 °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
TR1 (N-channel), Source-drain diode						
I_S	source current	T_{amb} = 25 °C	[2][1]	-	330	mA
TR2 (P-channel), Source-drain diode						
I_S	source current	T_{amb} = 25 °C	[1]	-	-170	mA
TR1 N-channel), ESD maximum rating						
V_{ESD}	electrostatic discharge voltage	HBM	[3]	-	2000	V
TR2 (P-channel), ESD maximum rating						
V_{ESD}	electrostatic discharge voltage	HBM	[3]	-	1000	V

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

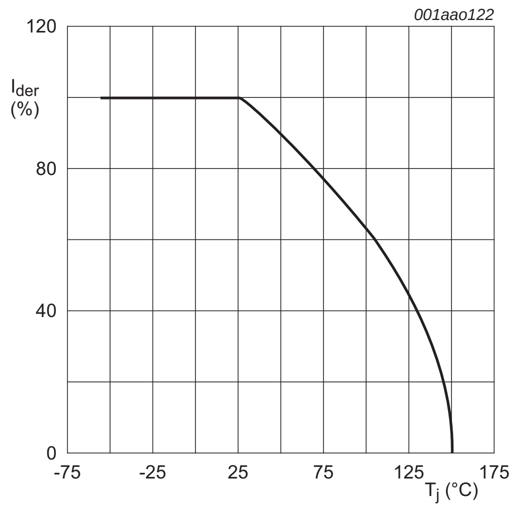
[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper; tin-plated and standard footprint.

[3] Measured between all pins.



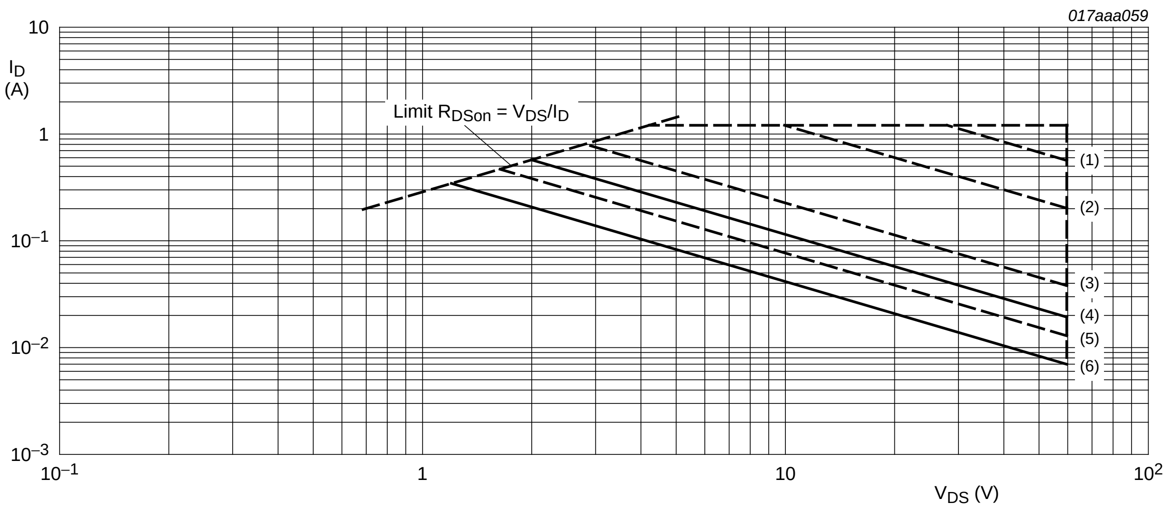
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ C)}} \times 100\,\%$$

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} = single pulse

(1) t_p = 100 μs

(2) t_p = 1 ms

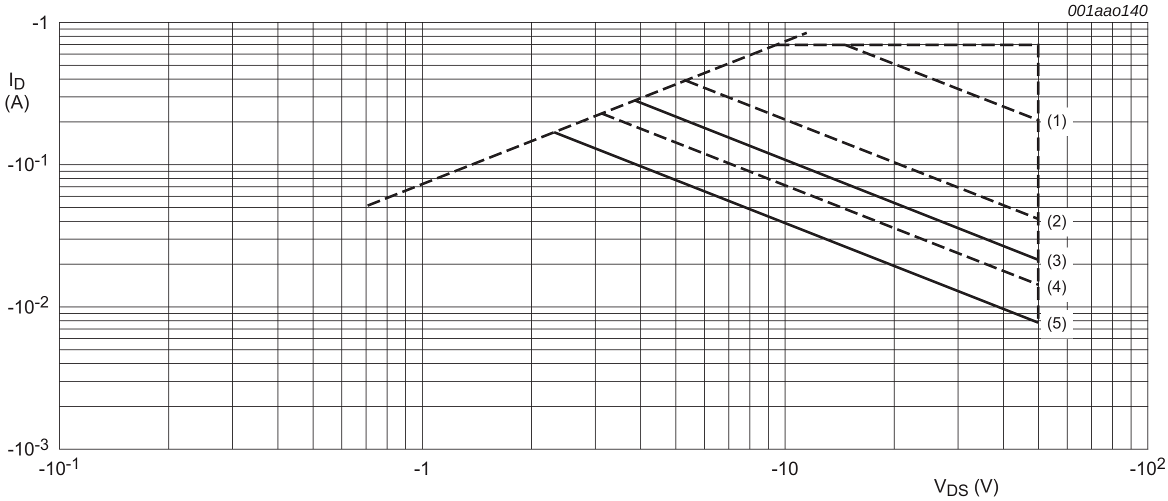
(3) t_p = 10 ms

(4) DC; T_{sp} = 25 °C

(5) t_p = 100 ms

(6) DC; T_{amb} = 25 °C; drain mounting pad 1 cm^2

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 single pulse

(1) t_p = 1 ms

(2) t_p = 10 ms

(3) DC; T_{sp} = 25 °C

(4) t_p = 100 ms

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

Fig 4. Safe operating area TR2 (P-channel); junction to ambient; continuous and peak drain currents as a function of drain-source voltage

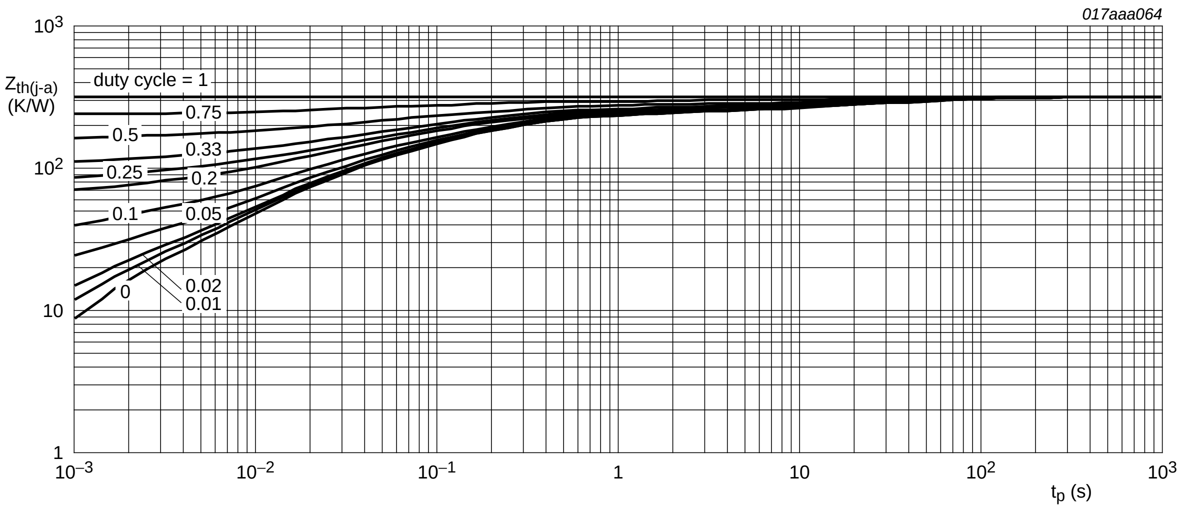
6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Per device							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	250	K/W
TR1 (N-channel)							
$R_{th(j-a)}$	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
TR2 (P-channel)							
$R_{th(j-a)}$	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

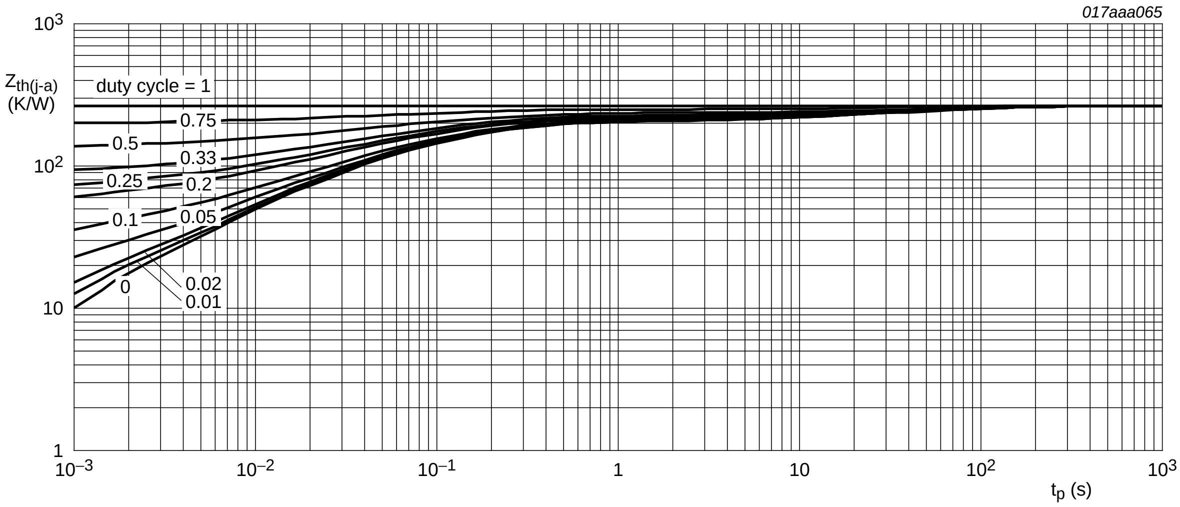
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper; tin-plated and standard footprint.

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



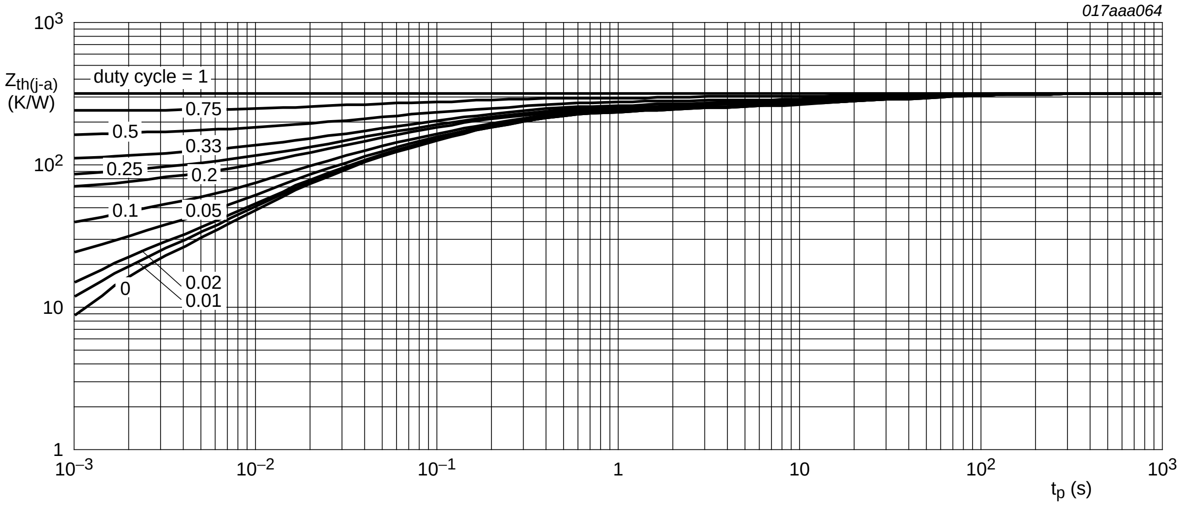
FR4 PCB, standard footprint

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



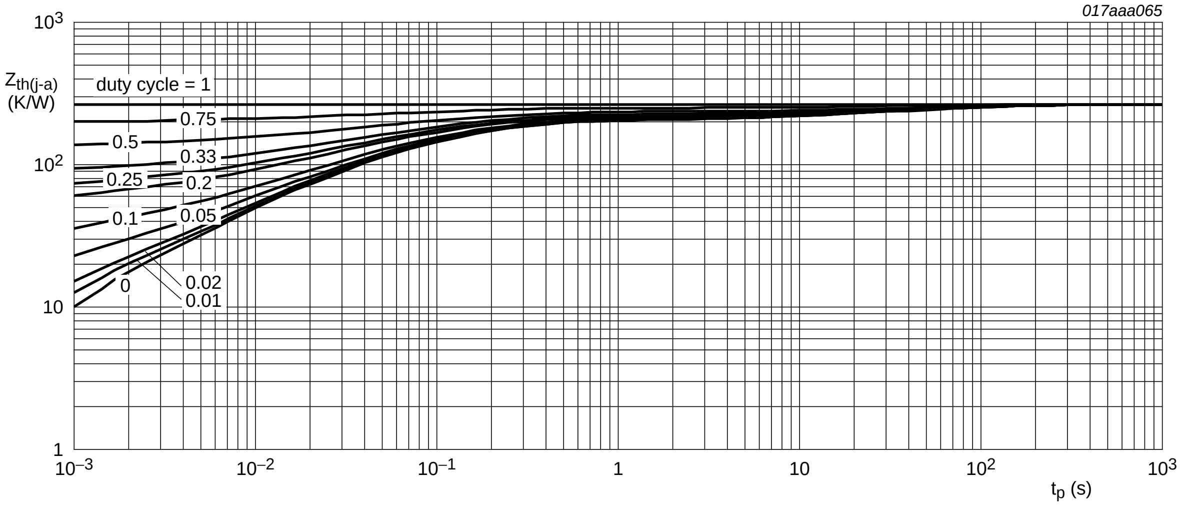
FR4 PCB, mounting pad for drain 1 cm^2

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



FR4 PCB, standard footprint

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



FR4 PCB, mounting pad for drain 1 cm^2

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

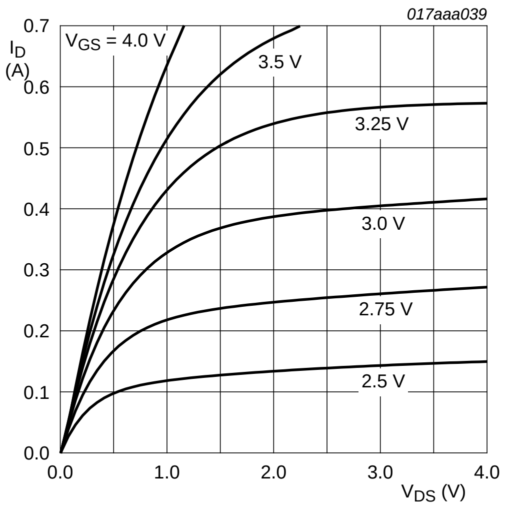
7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR2 (P-channel), Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = -10 µA; V_{GS} = 0 V; T_j = 25 °C	-50	-	-	V
V_{GSth}	gate-source threshold voltage	I_D = -250 µA; V_{DS} = V_{GS}; T_j = 25 °C	-1.1	-1.6	-2.1	V
I_{DSS}	drain leakage current	V_{DS} = -50 V; V_{GS} = 0 V; T_j = 25 °C	-	-	-1	µA
		V_{DS} = -50 V; V_{GS} = 0 V; T_j = 150 °C	-	-	-2	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C	-	-	-10	µA
		V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C	-	-	-10	µA
R_{DSon}	drain-source on-state resistance	V_{GS} = -10 V; I_D = -100 mA; T_j = 25 °C	-	4.5	7.5	Ω
		V_{GS} = -10 V; I_D = -100 mA; T_j = 150 °C	-	8	13.5	Ω
		V_{GS} = -5 V; I_D = -100 mA; T_j = 25 °C	-	5.1	8.5	Ω
g_{fs}	transfer conductance	V_{DS} = -10 V; I_D = -100 mA; T_j = 25 °C	-	150	-	mS
TR1 (N-channel), Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 10 µA; V_{GS} = 0 V; T_j = 25 °C	60	-	-	V
V_{GSth}	gate-source threshold voltage	I_D = 250 µA; V_{DS} = V_{GS}; T_j = 25 °C	1.1	1.6	2.1	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C	-	-	1	µA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 150 °C	-	-	10	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C	-	-	10	µA
		V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C	-	-	10	µA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 500 mA; pulsed; t_p ≤ 300 µs; δ ≤ 0.01 ; T_j = 25 °C	-	1	1.6	Ω
		V_{GS} = 10 V; I_D = 500 mA; pulsed; t_p ≤ 300 µs; δ ≤ 0.01 ; T_j = 150 °C	-	2.25	3.6	Ω
		V_{GS} = 5 V; I_D = 50 mA; pulsed; t_p ≤ 300 µs; δ ≤ 0.01 ; T_j = 25 °C	-	1.3	2	Ω
g_{fs}	transfer conductance	V_{DS} = 10 V; I_D = 100 mA; T_j = 25 °C	-	550	-	mS
TR2 (P-channel), Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	V_{DS} = -25 V; I_D = -180 mA; V_{GS} = -5 V; T_j = 25 °C	-	0.26	0.35	nC
Q_{GS}	gate-source charge		-	0.12	-	nC
Q_{GD}	gate-drain charge		-	0.09	-	nC
C_{iss}	input capacitance	V_{DS} = -25 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °C	-	24	36	pF
C_{oss}	output capacitance		-	4.5	-	pF
C_{rss}	reverse transfer capacitance		-	1.3	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = -30 V; R_L = 250 Ω; V_{GS} = -10 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °C	-	13	26	ns
t_r	rise time		-	11	-	ns
$t_{d(off)}$	turn-off delay time		-	48	96	ns
t_f	fall time		-	25	-	ns

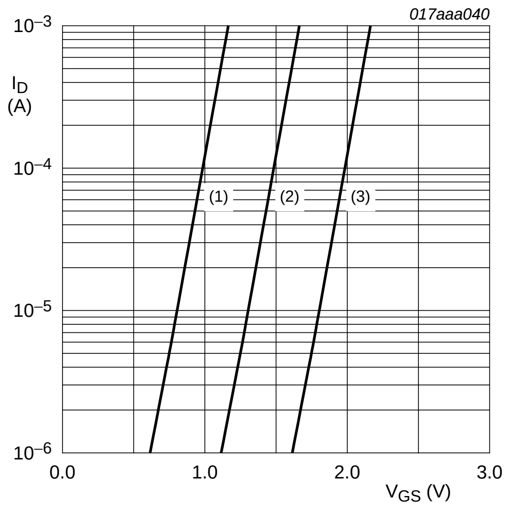
Table 7. Characteristics *...continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
TR1 (N-channel), Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	V_{DS} = 30 V; I_D = 300 mA; V_{GS} = 4.5 V; T_j = 25 °C	-	0.5	0.6	nC
Q_{GS}	gate-source charge		-	0.2	-	nC
Q_{GD}	gate-drain charge		-	0.1	-	nC
C_{iss}	input capacitance	V_{DS} = 10 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °C	-	33	50	pF
C_{oss}	output capacitance		-	7	-	pF
C_{rss}	reverse transfer capacitance		-	4	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 50 V; R_L = 250 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °C	-	5	10	ns
t_r	rise time		-	6	-	ns
$t_{d(off)}$	turn-off delay time		-	12	24	ns
t_f	fall time		-	7	-	ns
TR2 (P-channel), Source-drain diode characteristics						
V_{SD}	source-drain voltage	I_S = -115 mA; V_{GS} = 0 V; T_j = 25 °C	-0.48	-0.85	-1.2	V
TR1 (N-channel), Source-drain diode characteristics						
V_{SD}	source-drain voltage	I_S = 115 mA; V_{GS} = 0 V; T_j = 25 °C	0.47	0.75	1.1	V



T_j = 25 °C

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



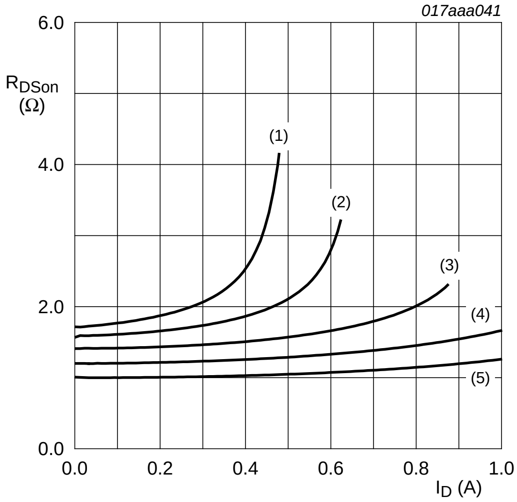
T_j = 25 °C; V_{DS} = 5 V

(1) minimum values

(2) typical values

(3) maximum values

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



T_j = 25 °C

(1) V_{GS} = 3.25 V

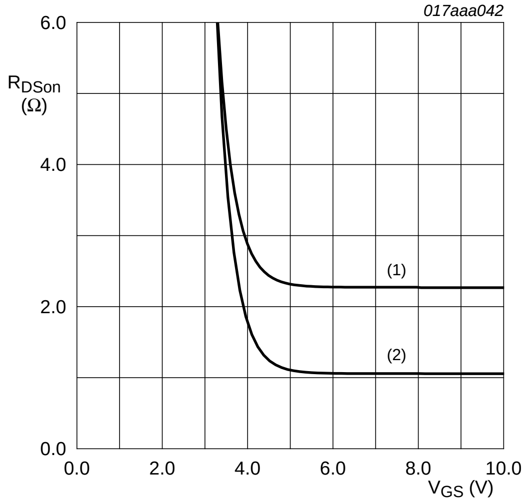
(2) V_{GS} = 3.5 V

(3) V_{GS} = 4 V

(4) V_{GS} = 5 V

(5) V_{GS} = 10 V

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

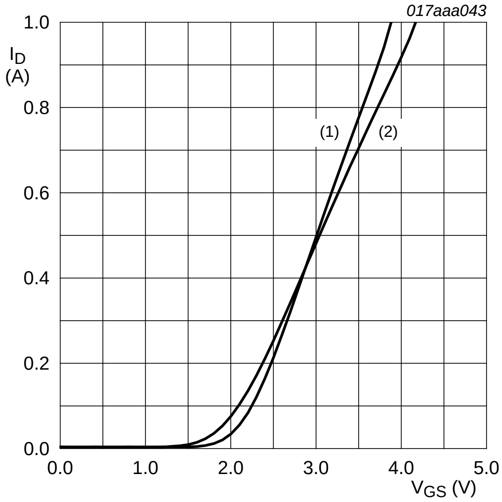


I_D = 500 mA; pulsed; t_p ≤ 300 μs; δ ≤ 0.01

(1) T_j = 150 °C

(2) T_j = 25 °C

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

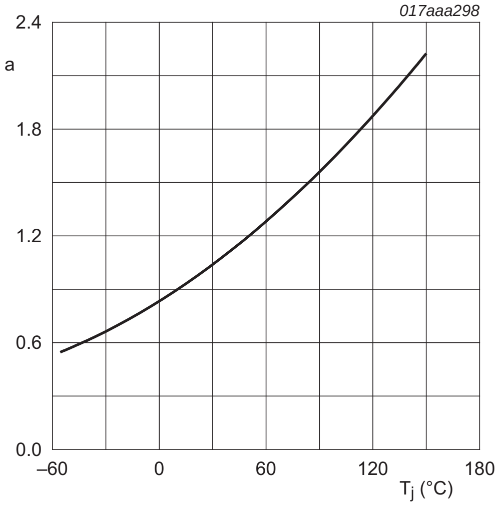


V_{DS} > I_D x R_{DSon}

(1) T_j = 25 °C

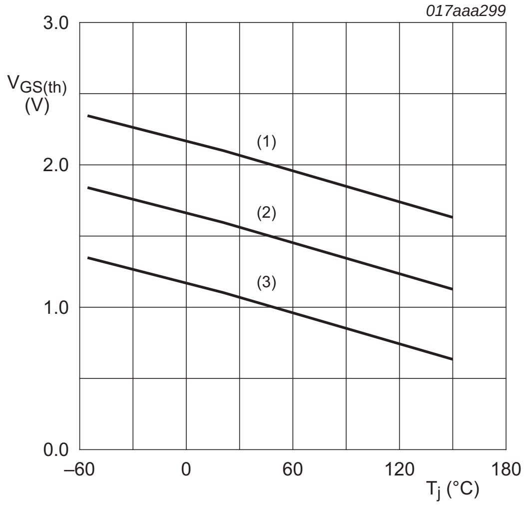
(2) T_j = 150 °C

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



$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



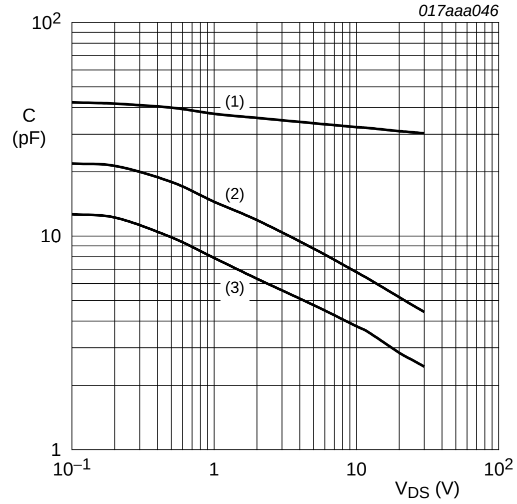
I_D = 0.25 mA; V_{DS} = V_{GS}

(1) maximum values

(2) typical values

(3) minimum values

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



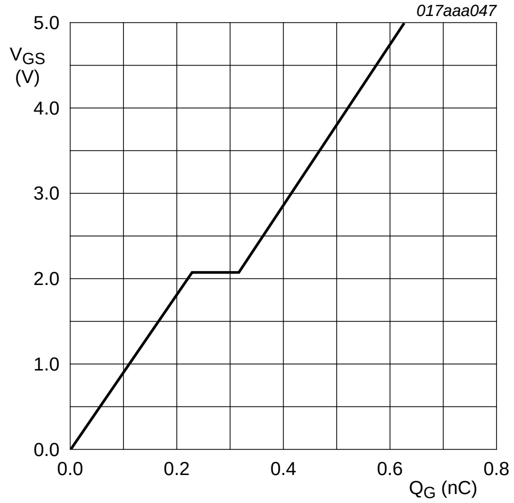
f = 1 MHz; V_{GS} = 0 V

(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 = 300 mA; V_{DS} = 30 V; T_{amb} = 25 °C

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

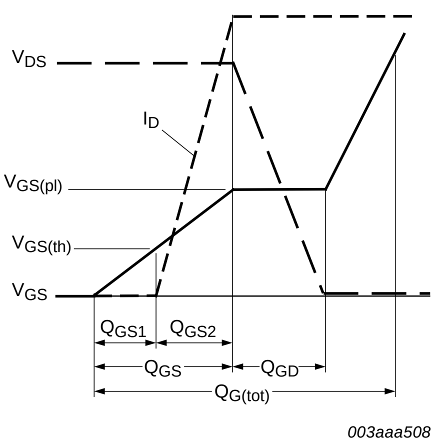
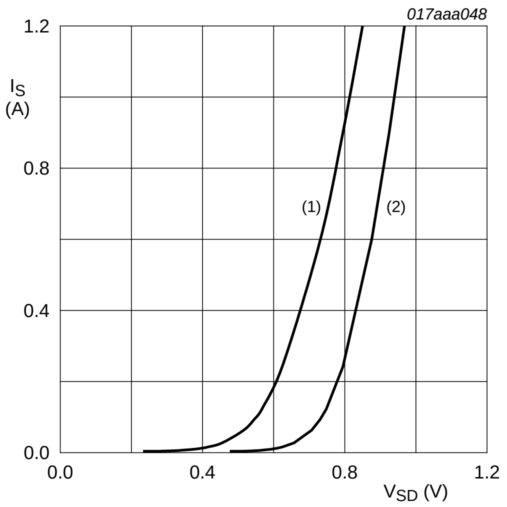


Fig 18. Gate charge waveform definitions

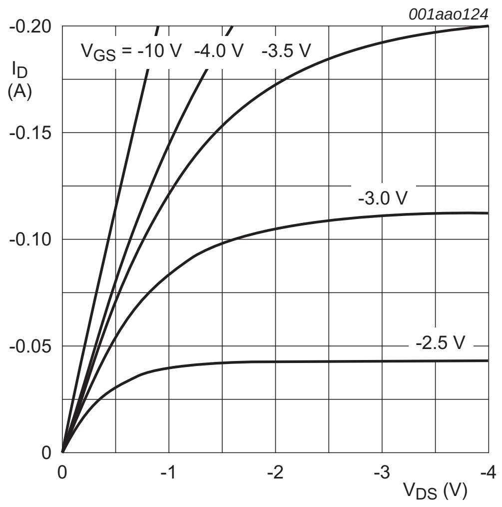


V_{GS} = 0 V

(1) T_j = 150 °C

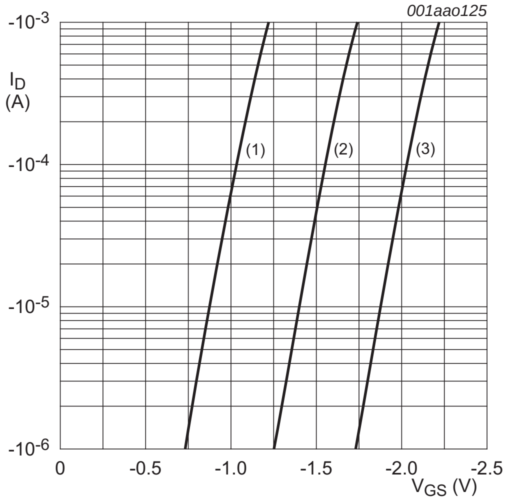
(2) T_j = 25 °C

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



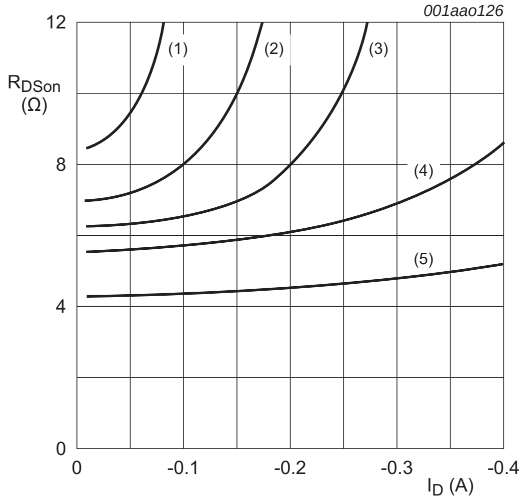
T_j = 25 °C; V_{DS} = -5 V

(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 °C

(1) V_{GS} = -3.0 V

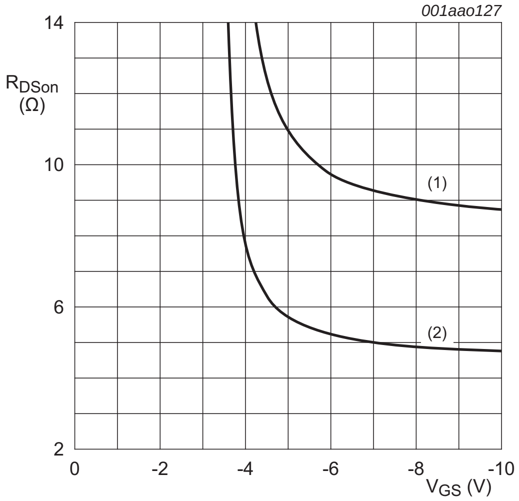
(2) V_{GS} = -3.5 V

(3) V_{GS} = -4.0 V

(4) V_{GS} = -5.0 V

(5) V_{GS} = -10.0 V

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

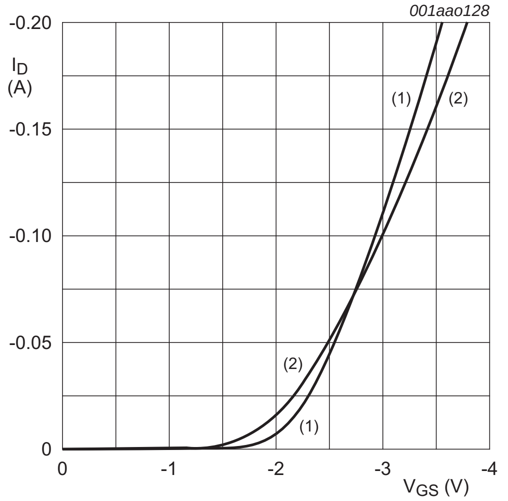


I_D = -200 mA

(1) T_j = 150 °C

(2) T_j = 25 °C

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

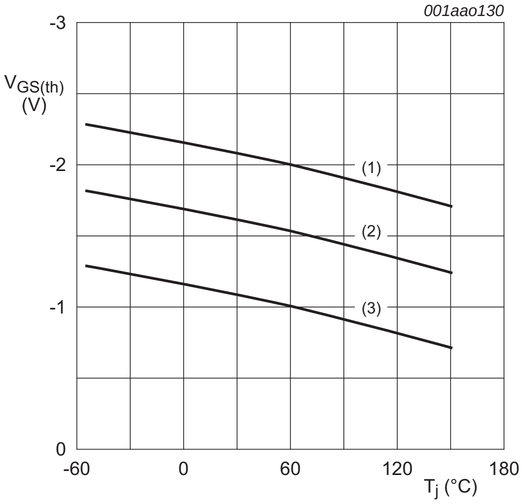


$V_{DS} > I_D \times R_{DSon}$

(1) T_j = 25 °C

(2) T_j = 150 °C

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



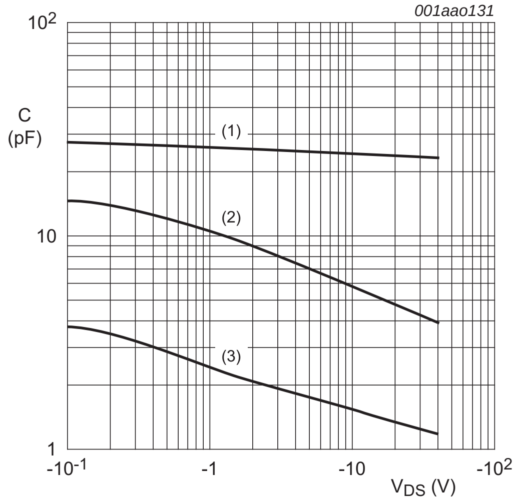
I_D = -0.25 mA; $V_{DS} = V_{GS}$

(1) maximum values

(2) typical values

(3) minimum values

Fig 25. TR2: Gate-source threshold voltage as a function of junction temperature



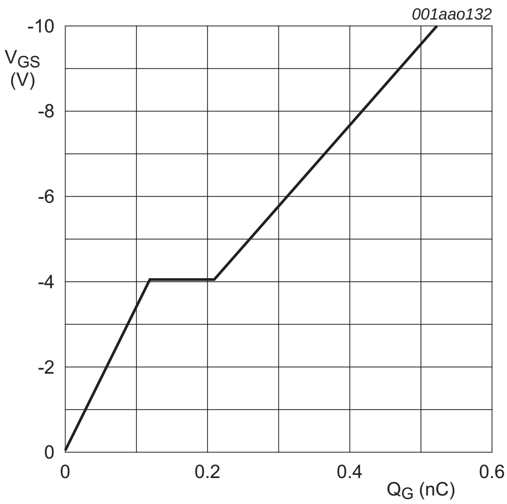
f = 1 MHz; V_{GS} = 0 V

(1) C_{iss}

(2) C_{oss}

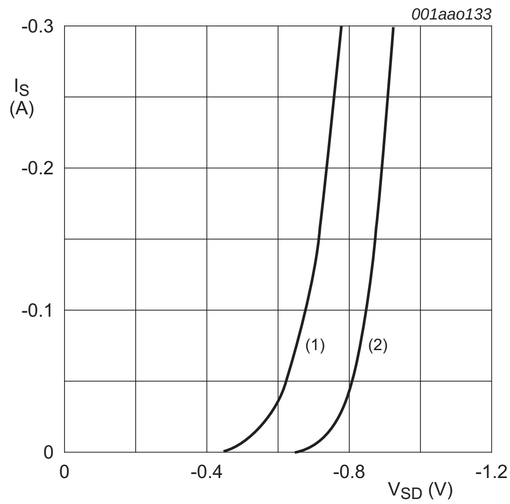
(3) C_{rss}

Fig 26. TR2: Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



I_D = -180 mA; V_{DS} = -25 V; T_{amb} = 25 °C

Fig 27. TR2: Gate-source voltage as a function of gate charge; typical values



V_{GS} = 0 V

(1) T_j = 150 °C

(2) T_j = 25 °C

Fig 28. TR2: Source current as a function of source-drain voltage; typical values

8. Test information

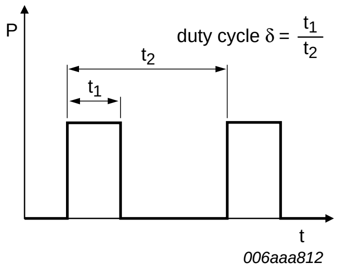


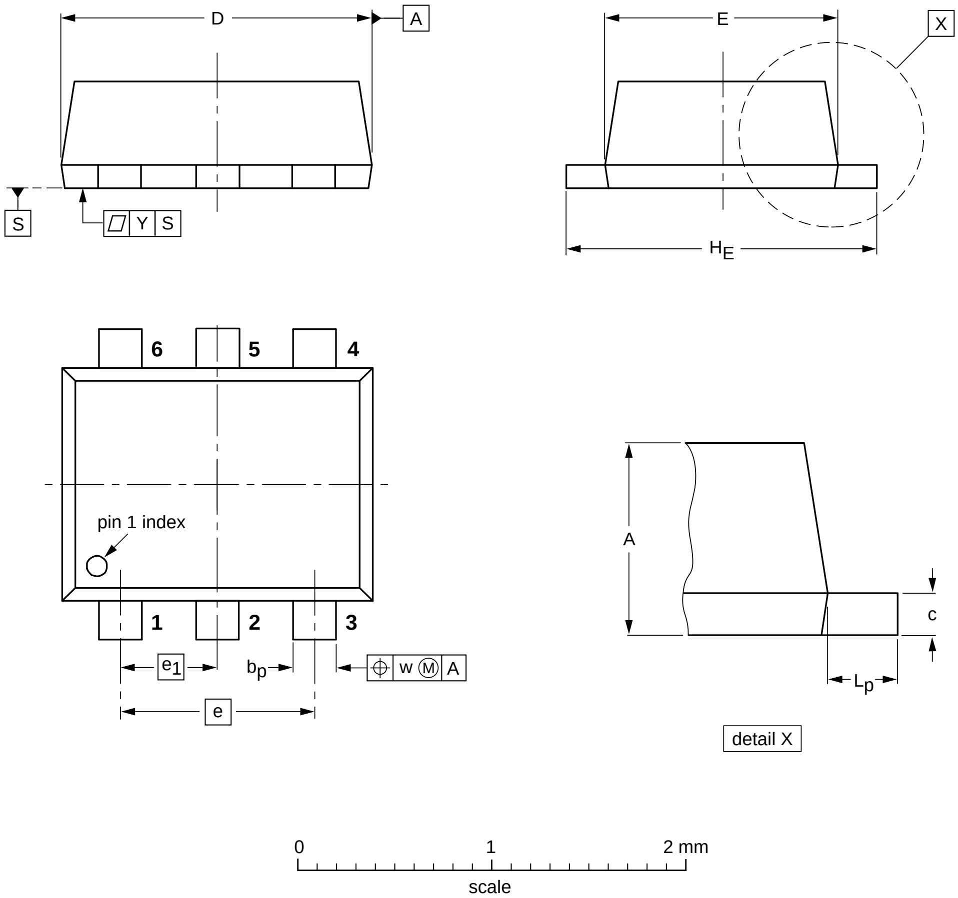
Fig 29. Duty cycle definition

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**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_p	c	D	E	e	e_1	H_E	L_p	w	y
mm	0.6 0.5	0.27 0.17	0.18 0.08	1.7 1.5	1.3 1.1	1.0	0.5	1.7 1.5	0.3 0.1	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT666						~~04-11-08~~ 06-03-16

Fig 30. Package outline SOT666 (SOT666)

10. Soldering

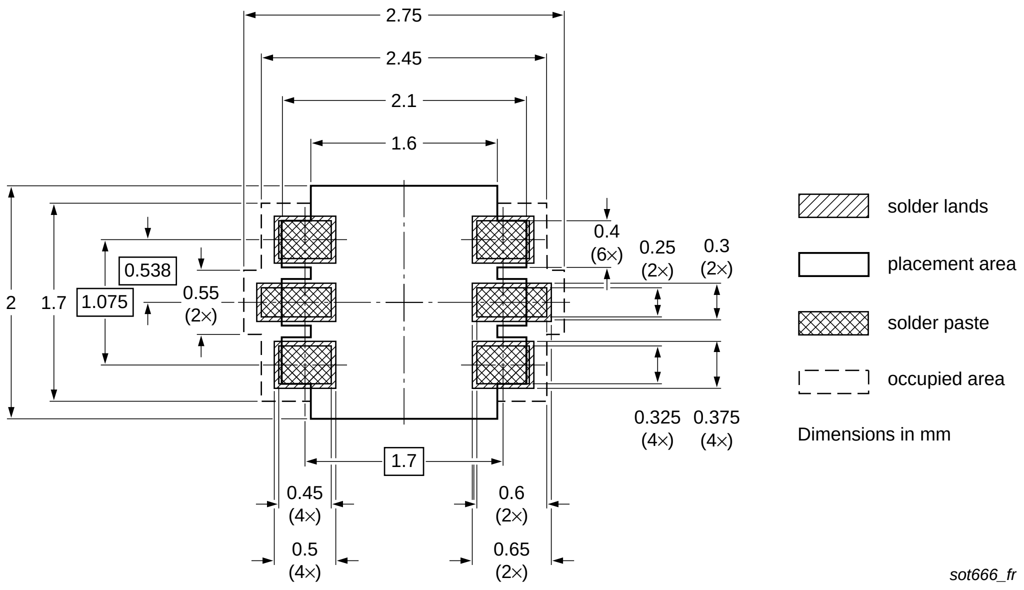


Fig 31. Reflow soldering footprint for SOT666 (SOT666)

11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX1029X v.1	20110812	Product data sheet	-	-

12. Legal information

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".

[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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14. Contents

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Date of release: 12 August 2011