



# PMDT290UCE

20 / 20 V, 800 / 550 mA N/P-channel Trench MOSFET

28 December 2022

Product data sheet

## 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.

## 2. Features and benefits

- Very fast switching
- Trench MOSFET technology
- ESD protection up to 2 kV

## 3. Applications

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

## 4. Quick reference data

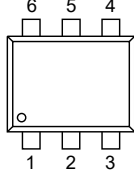
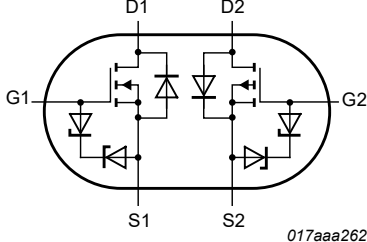
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR1 (N-channel), Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5 \text{ V}; I_D = 500 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	290	380	m $\Omega$
<b>TR2 (P-channel), Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = -4.5 \text{ V}; I_D = -400 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	0.67	0.85	$\Omega$
<b>TR1 (N-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25 \text{ }^\circ\text{C}$	-	-	20	V
$V_{GS}$	gate-source voltage		-8	-	8	V
$I_D$	drain current	$V_{GS} = 4.5 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	-	800	mA
<b>TR2 (P-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25 \text{ }^\circ\text{C}$	-	-	-20	V
$V_{GS}$	gate-source voltage		-8	-	8	V
$I_D$	drain current	$V_{GS} = -4.5 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$	[1]	-	-550	mA

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

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source TR1	 <p><b>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		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMDT290UCE	SOT666	plastic, surface-mounted package; 6 leads; 0.5 mm pitch; 1.6 mm x 1.2 mm x 0.55 mm body	SOT666

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PMDT290UCE	AF

## 8. Limiting values

**Table 5. Limiting values**

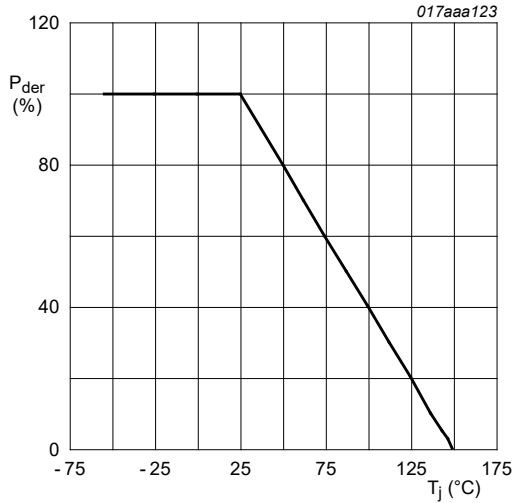
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
<b>TR1 (N-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$		-	20	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]	-	800	mA
		$V_{GS} = 4.5\text{ V}; T_{amb} = 100\text{ °C}$	[1]	-	500	mA
$I_{DM}$	peak drain current	$T_{amb} = 25\text{ °C};$ single pulse; $t_p \leq 10\text{ }\mu\text{s}$		-	3.2	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>TR2 (P-channel)</b>						
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$		-	-20	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]	-	-550	mA
		$V_{GS} = -4.5\text{ V}; T_{amb} = 100\text{ °C}$	[1]	-	-350	mA
$I_{DM}$	peak drain current	$T_{amb} = 25\text{ °C};$ single pulse; $t_p \leq 10\text{ }\mu\text{s}$		-	-2.2	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]	-	370	mA
<b>TR2 (P-channel), Source-drain diode</b>						
$I_S$	source current	$T_{amb} = 25\text{ °C}$	[1]	-	-370	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  $1\text{ cm}^2$ .

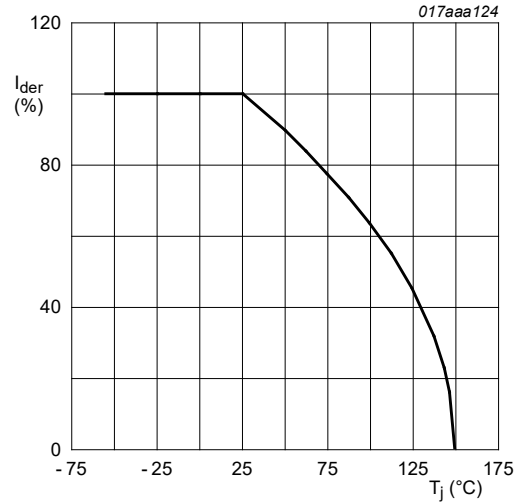
[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper; tin-plated and standard footprint.

[3] Measured between all pins.



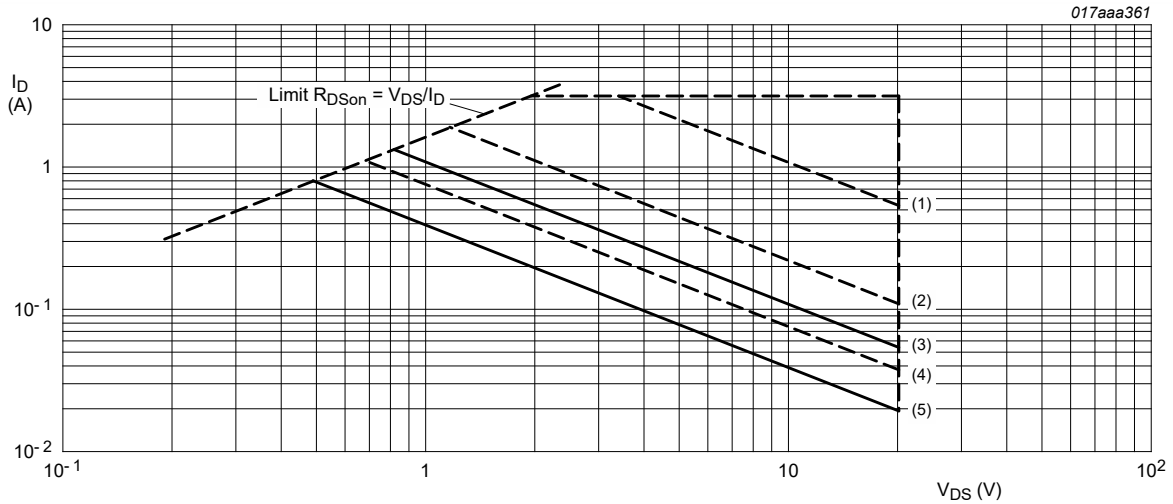
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ\text{C})}} \times 100 \%$$

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



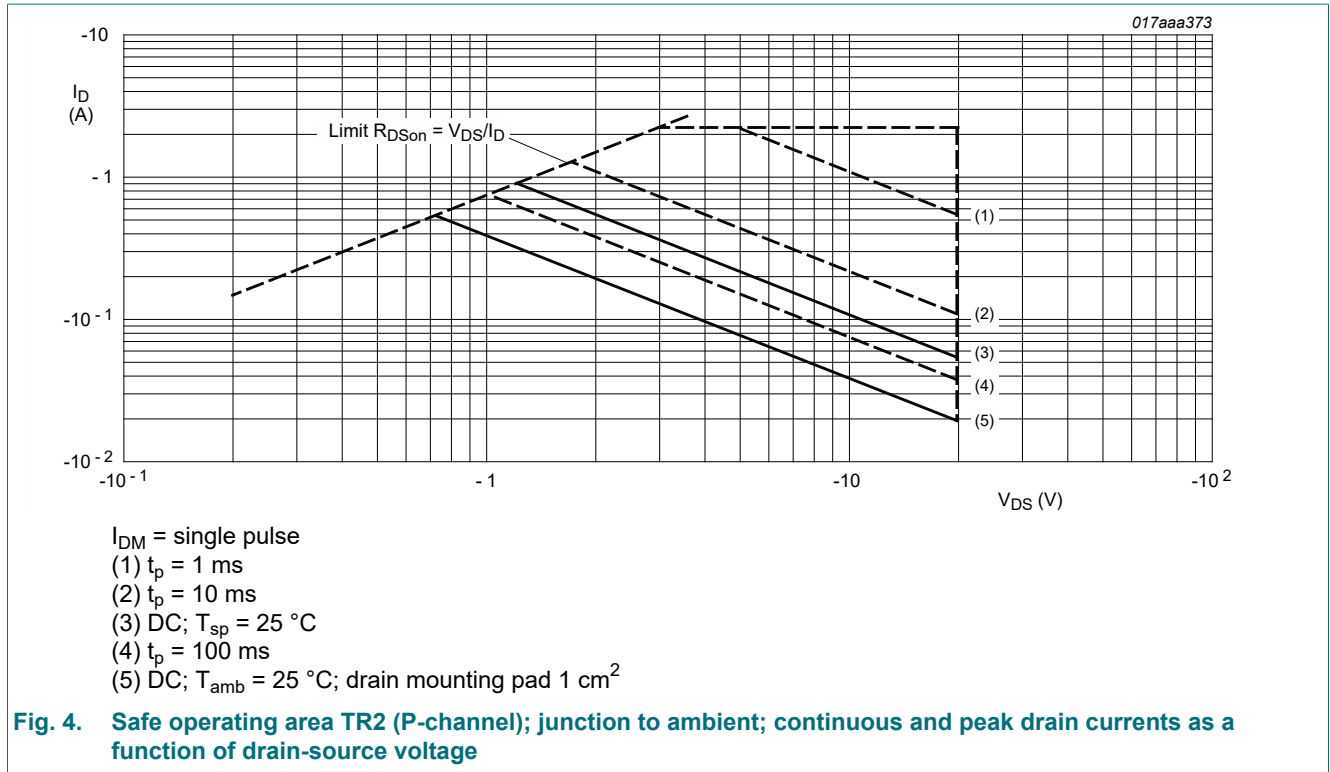
$$I_{der} = \frac{I_D}{I_{D(25^\circ\text{C})}} \times 100 \%$$

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



- $I_{DM}$  = single pulse
- (1)  $t_p = 1 \text{ ms}$
  - (2)  $t_p = 10 \text{ ms}$
  - (3) DC;  $T_{sp} = 25^\circ\text{C}$
  - (4)  $t_p = 100 \text{ ms}$
  - (5) DC;  $T_{amb} = 25^\circ\text{C}$ ; drain mounting pad  $1 \text{ cm}^2$

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



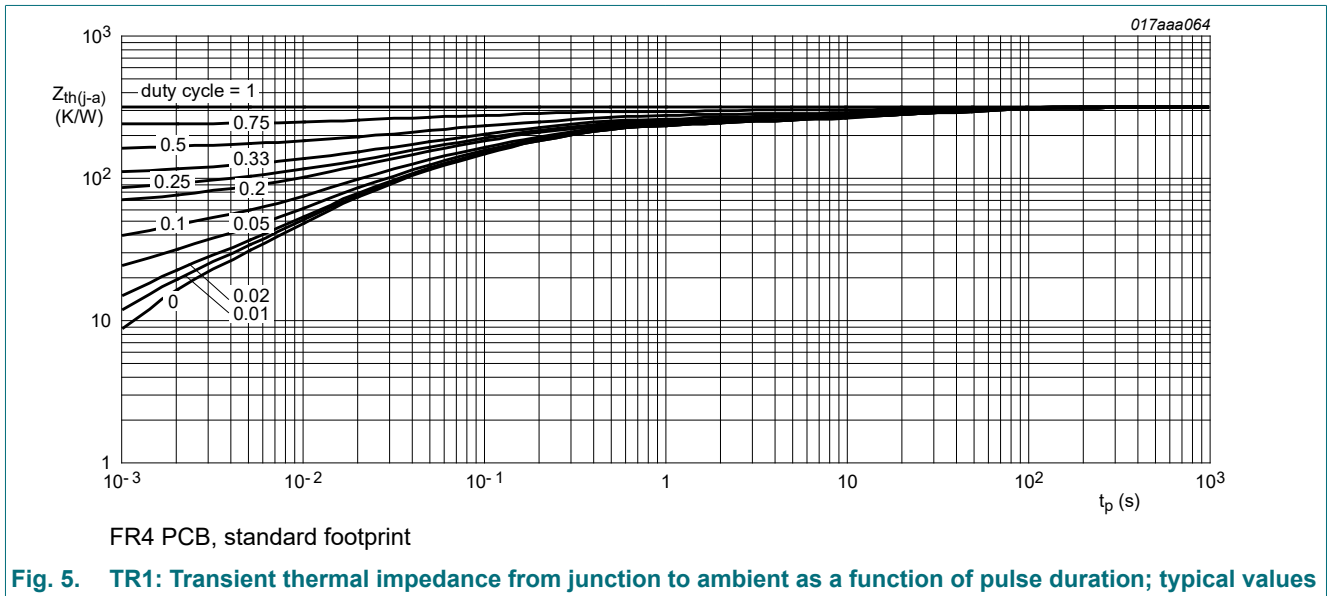
## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<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
<b>Per device</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	250	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<sup>2</sup>.



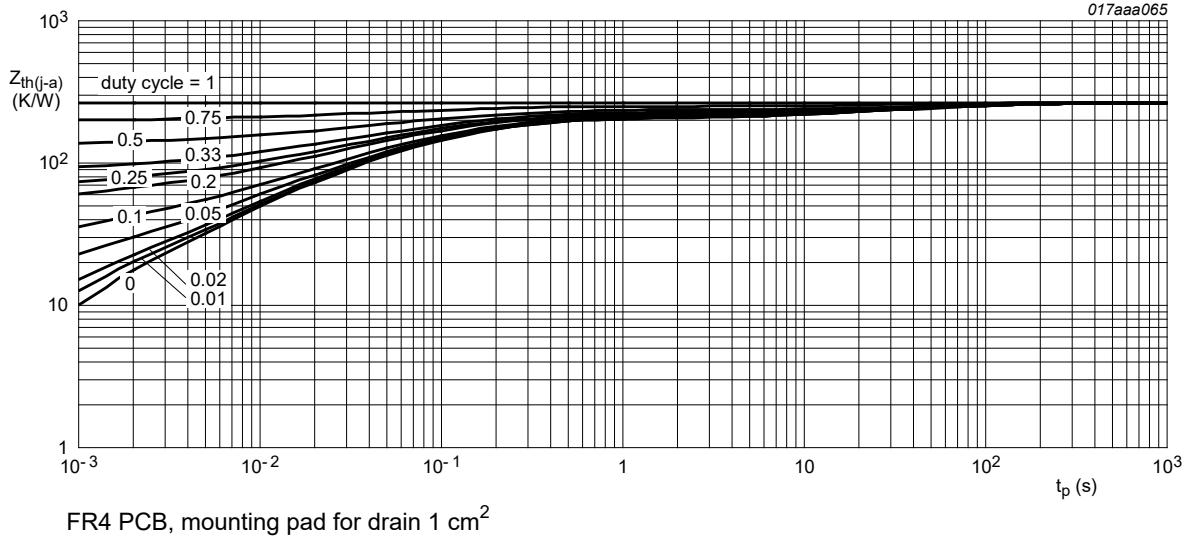


Fig. 6. TR1: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

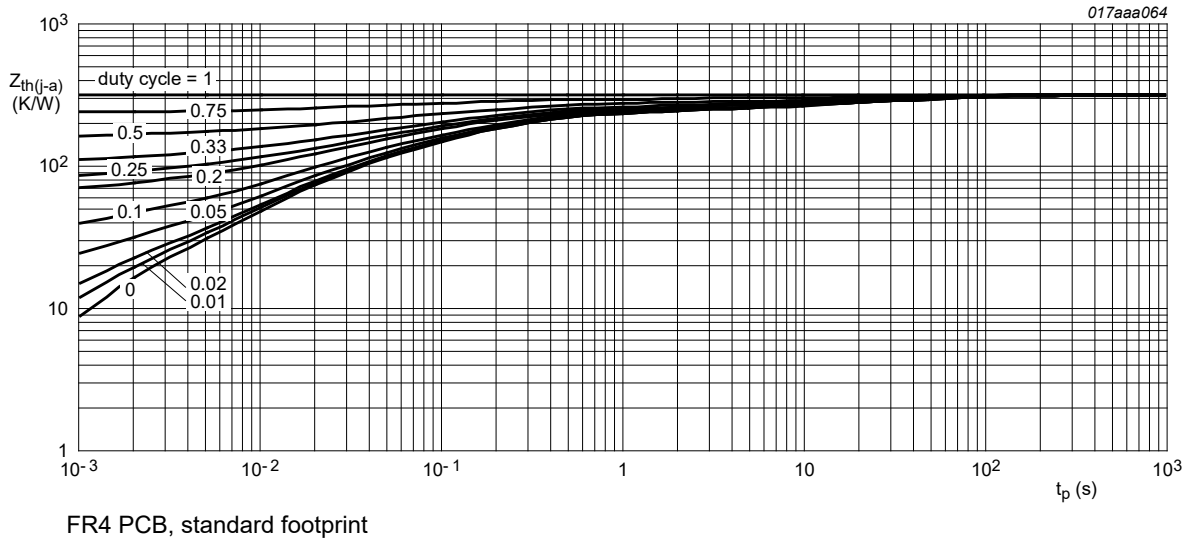


Fig. 7. TR2: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

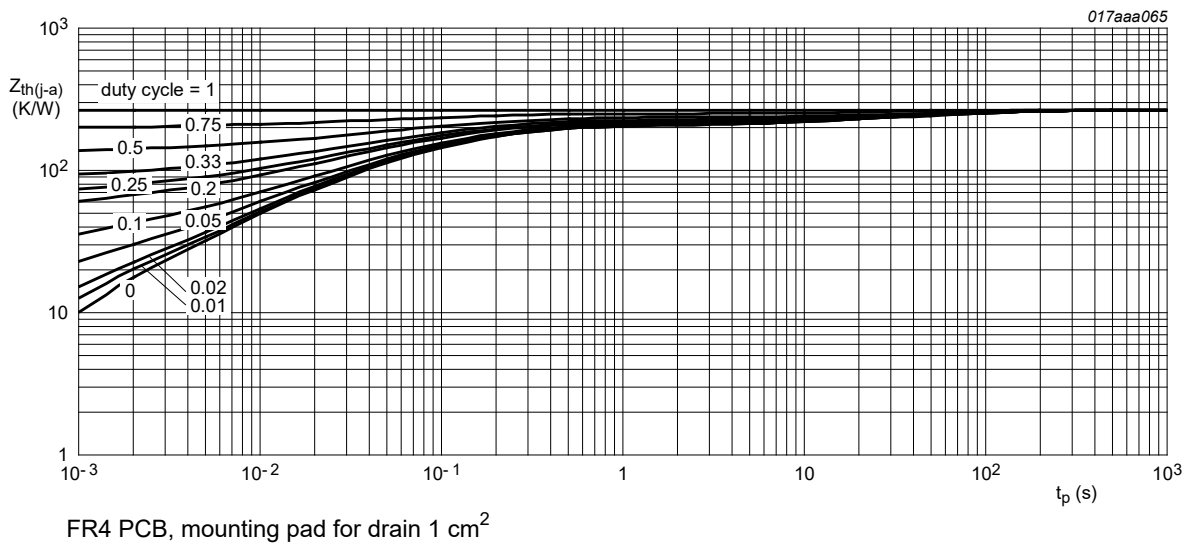


Fig. 8. TR2: Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>TR1 (N-channel), Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	20	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu A; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	0.5	0.75	0.95	V
$I_{DSS}$	drain leakage current	$V_{DS} = 20 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	1	$\mu A$
		$V_{DS} = 20 V; V_{GS} = 0 V; T_j = 150 \text{ }^\circ C$	-	-	10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 8 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	2	$\mu A$
		$V_{GS} = -8 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	2	$\mu A$
		$V_{GS} = 4.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	500	nA
		$V_{GS} = -4.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	500	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5 V; I_D = 500 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	290	380	m $\Omega$
		$V_{GS} = 4.5 V; I_D = 500 \text{ mA}; T_j = 150 \text{ }^\circ C$	-	460	610	m $\Omega$
		$V_{GS} = 2.5 V; I_D = 200 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	420	620	m $\Omega$
		$V_{GS} = 1.8 V; I_D = 10 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	0.6	1.1	$\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = 10 V; I_D = 200 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	1.6	-	S
<b>TR2 (P-channel), Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = -250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-20	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = -250 \mu A; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	-0.5	-0.8	-1.3	V
$I_{DSS}$	drain leakage current	$V_{DS} = -20 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	-1	$\mu A$
		$V_{DS} = -20 V; V_{GS} = 0 V; T_j = 150 \text{ }^\circ C$	-	-	-10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = -8 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	-2	$\mu A$
		$V_{GS} = 8 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	-2	$\mu A$
		$V_{GS} = -4.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	-0.5	$\mu A$
		$V_{GS} = 4.5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	-0.5	$\mu A$
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = -4.5 V; I_D = -400 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	0.67	0.85	$\Omega$
		$V_{GS} = -4.5 V; I_D = -400 \text{ mA}; T_j = 150 \text{ }^\circ C$	-	1.1	1.4	$\Omega$
		$V_{GS} = -2.5 V; I_D = -200 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	1.2	1.5	$\Omega$
		$V_{GS} = -1.8 V; I_D = -10 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	1.8	2.8	$\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = -10 V; I_D = -200 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	610	-	mS
<b>TR1 (N-channel), Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 10 V; I_D = 500 \text{ mA}; V_{GS} = 4.5 V; T_j = 25 \text{ }^\circ C$	-	0.45	0.68	nC
$Q_{GS}$	gate-source charge		-	0.15	-	nC
$Q_{GD}$	gate-drain charge		-	0.15	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 10 V; f = 1 \text{ MHz}; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	55	83	pF
$C_{oss}$	output capacitance		-	15	-	pF
$C_{rss}$	reverse transfer capacitance		-	7	-	pF



Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	turn-on delay time	$V_{DS} = 10\text{ V}; R_L = 250\ \Omega; V_{GS} = 4.5\text{ V};$ $R_{G(ext)} = 6\ \Omega; T_j = 25\text{ }^\circ\text{C}$	-	6	12	ns
$t_r$	rise time		-	4	-	ns
$t_{d(off)}$	turn-off delay time		-	86	172	ns
$t_f$	fall time		-	31	-	ns
<b>TR2 (P-channel), Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = -10\text{ V}; I_D = -400\text{ mA};$ $V_{GS} = -4.5\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	0.76	1.14	nC
$Q_{GS}$	gate-source charge		-	0.28	-	nC
$Q_{GD}$	gate-drain charge		-	0.18	-	nC
$C_{iss}$	input capacitance	$V_{DS} = -10\text{ V}; f = 1\text{ MHz}; V_{GS} = 0\text{ V};$ $T_j = 25\text{ }^\circ\text{C}$	-	58	87	pF
$C_{oss}$	output capacitance		-	21	-	pF
$C_{rss}$	reverse transfer capacitance		-	12	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = -10\text{ V}; R_L = 250\ \Omega; V_{GS} = -4.5\text{ V};$ $R_{G(ext)} = 6\ \Omega; T_j = 25\text{ }^\circ\text{C}$	-	18	36	ns
$t_r$	rise time		-	30	-	ns
$t_{d(off)}$	turn-off delay time		-	80	160	ns
$t_f$	fall time		-	72	-	ns
<b>TR1 (N-channel), Source-drain diode characteristics</b>						
$V_{SD}$	source-drain voltage	$I_S = 300\text{ mA}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$	0.48	0.77	1.2	V
<b>TR2 (P-channel), Source-drain diode characteristics</b>						
$V_{SD}$	source-drain voltage	$I_S = -300\text{ mA}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-0.48	-0.84	-1.2	V

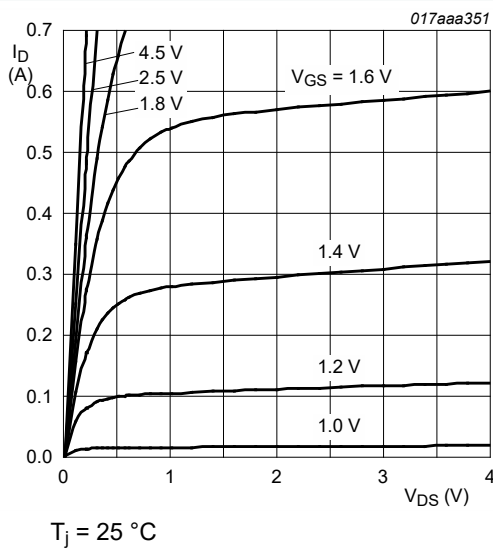


Fig. 9. TR1; Output characteristics: drain current as a function of drain-source voltage; typical values

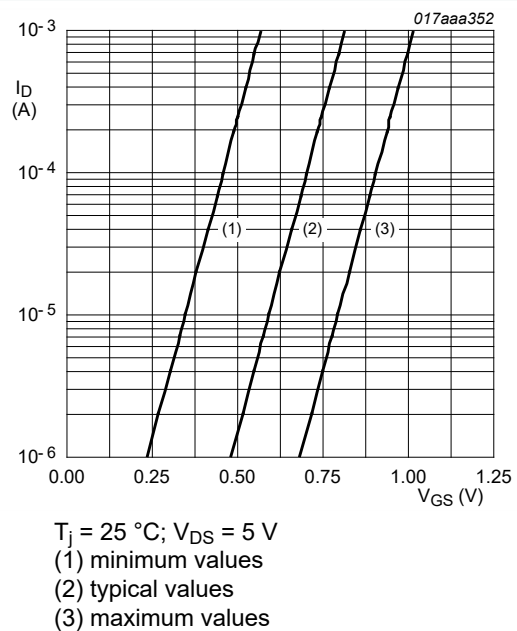
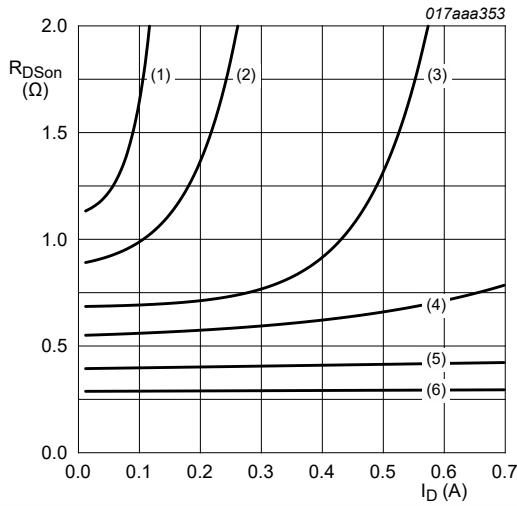
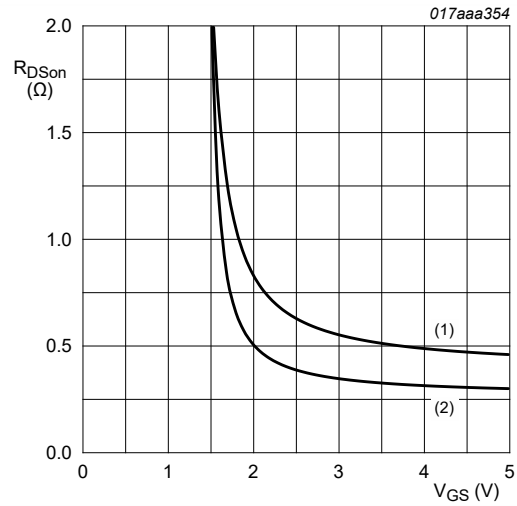


Fig. 10. TR1; Sub-threshold drain current as a function of gate-source voltage



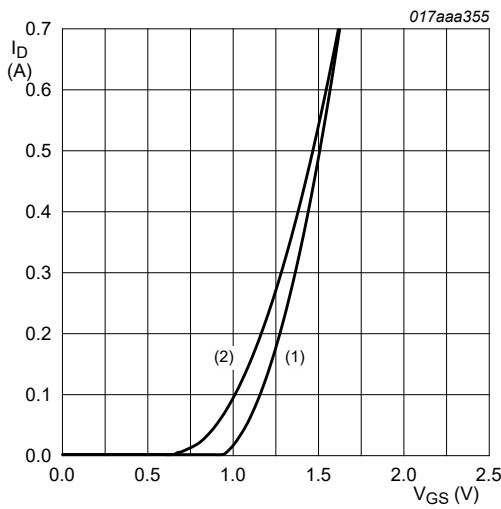
$T_j = 25\text{ }^\circ\text{C}$   
 (1)  $V_{GS} = 1.3\text{ V}$   
 (2)  $V_{GS} = 1.4\text{ V}$   
 (3)  $V_{GS} = 1.6\text{ V}$   
 (4)  $V_{GS} = 1.8\text{ V}$   
 (5)  $V_{GS} = 2.5\text{ V}$   
 (6)  $V_{GS} = 4.5\text{ V}$

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



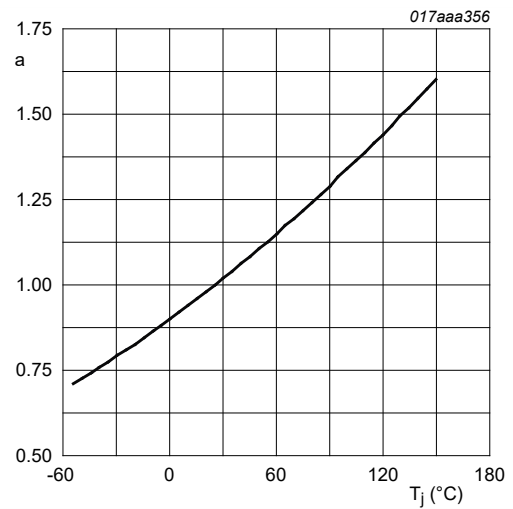
$I_D = 400\text{ mA}$   
 (1)  $T_j = 150\text{ }^\circ\text{C}$   
 (2)  $T_j = 25\text{ }^\circ\text{C}$

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



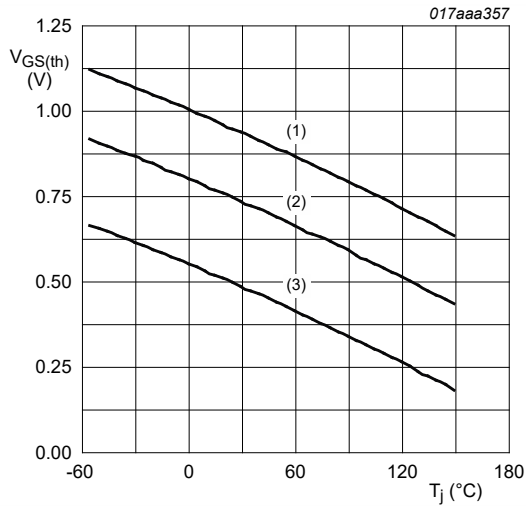
$V_{DS} > I_D \times R_{DSon}$   
 (1)  $T_j = 25\text{ }^\circ\text{C}$   
 (2)  $T_j = 150\text{ }^\circ\text{C}$

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



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

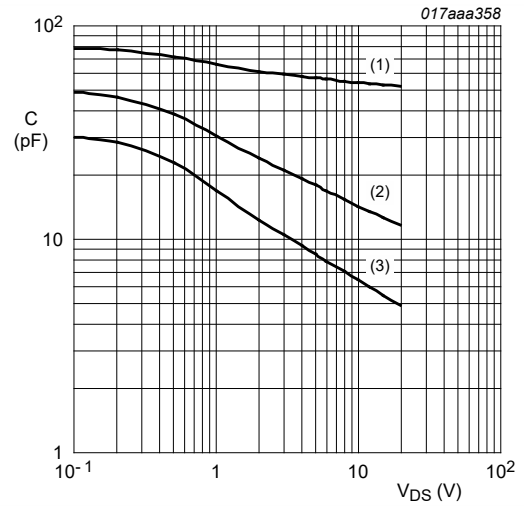
Fig. 14. TR1; Normalized drain-source on-state resistance as a function of junction temperature; typical values



$I_D = 0.25 \text{ mA}; V_{DS} = V_{GS}$

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

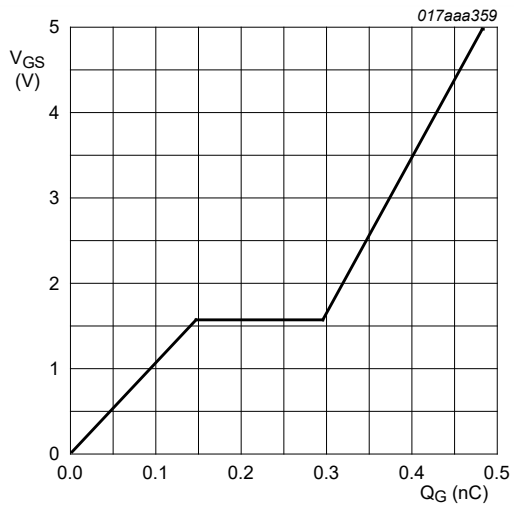
**Fig. 15. TR1; Gate-source threshold voltage as a function of junction temperature**



$f = 1 \text{ MHz}; V_{GS} = 0 \text{ V}$

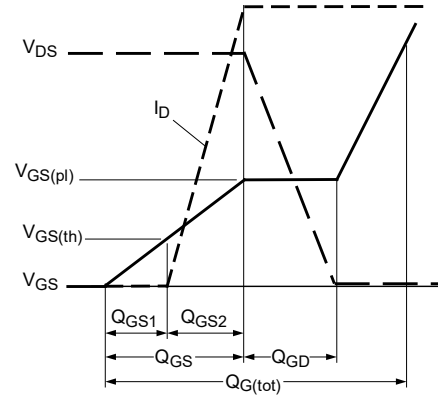
- (1)  $C_{iss}$
- (2)  $C_{oss}$
- (3)  $C_{rss}$

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



$I_D = 0.5 \text{ A}; V_{DS} = 10 \text{ V}; T_{amb} = 25 \text{ °C}$

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



**Fig. 18. Gate charge waveform definitions**

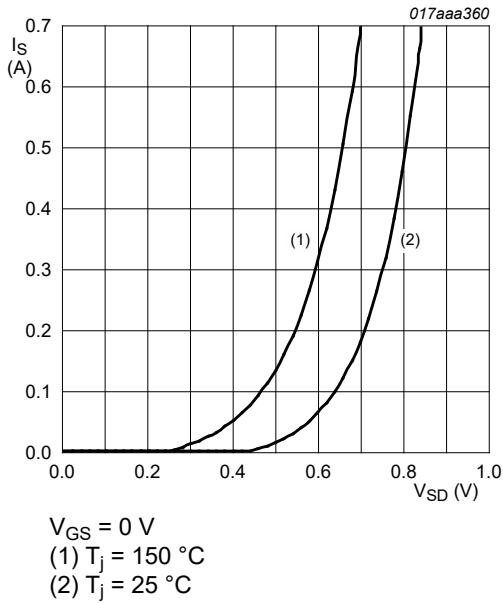


Fig. 19. TR1; Source current as a function of source-drain voltage; typical values

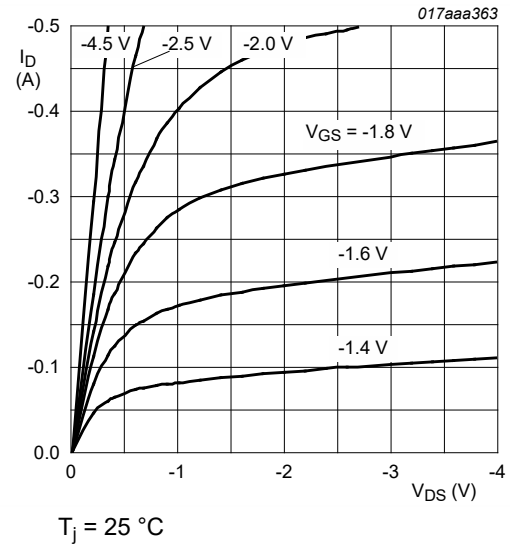


Fig. 20. TR2; Output characteristics: drain current as a function of drain-source voltage; typical values

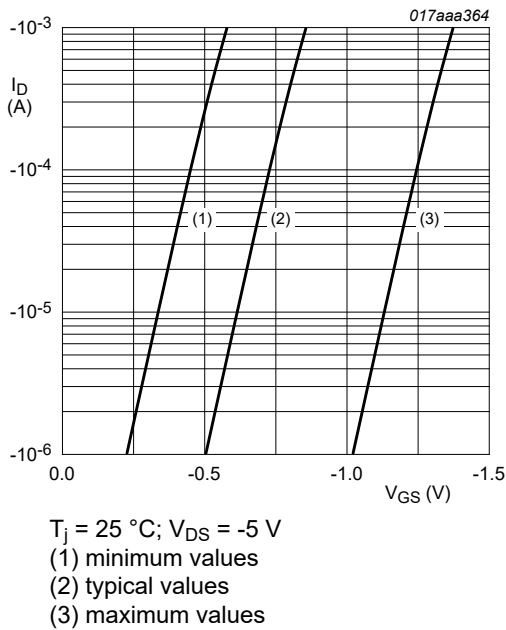


Fig. 21. TR2; Sub-threshold drain current as a function of gate-source voltage

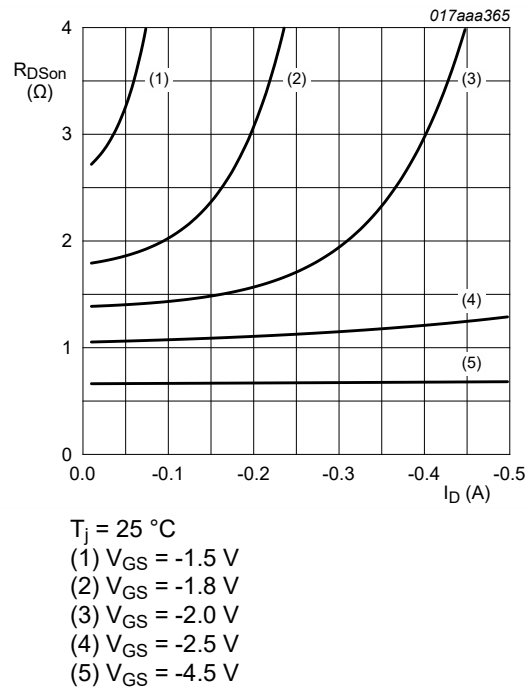


Fig. 22. TR2; Drain-source on-state resistance as a function of drain current; typical values

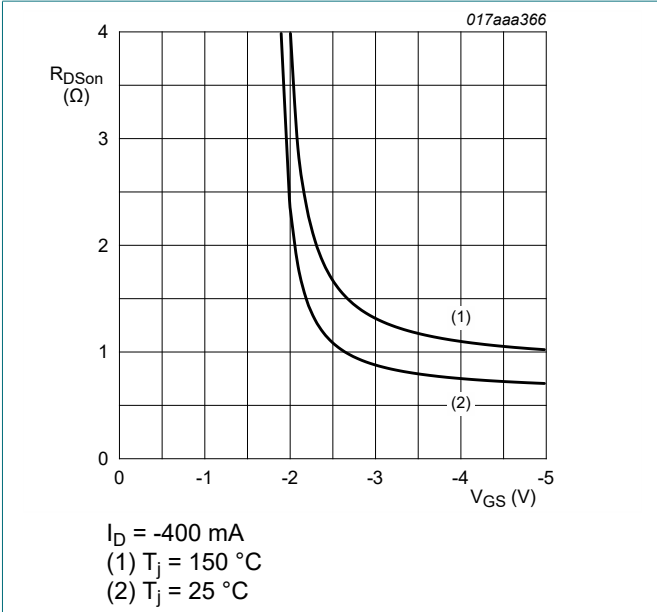


Fig. 23. TR2; Drain-source on-state resistance as a function of gate-source voltage; typical values

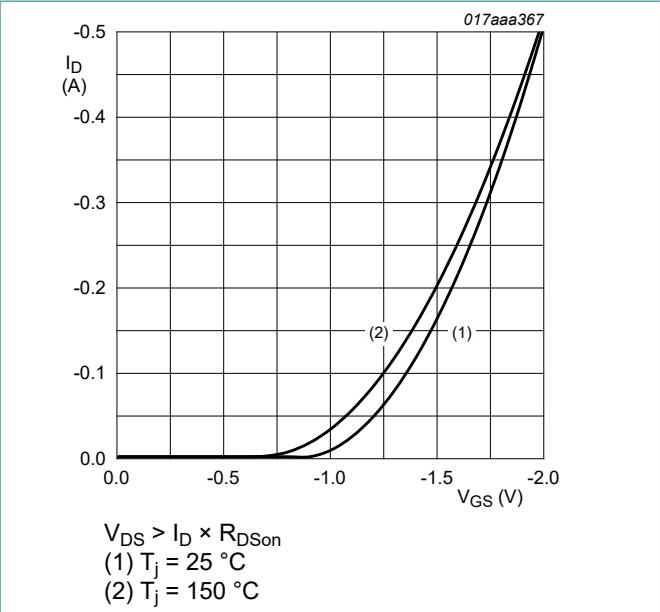


Fig. 24. TR2; Transfer characteristics: drain current as a function of gate-source voltage; typical values

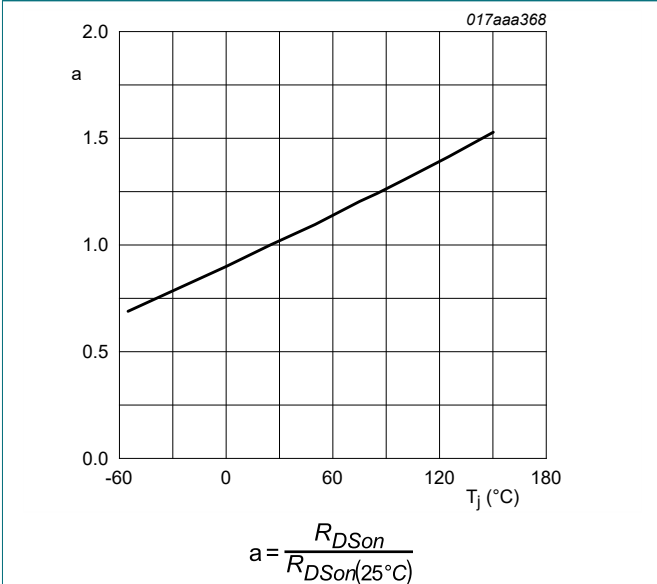


Fig. 25. TR2; Normalized drain-source on-state resistance as a function of ambient temperature; typical values

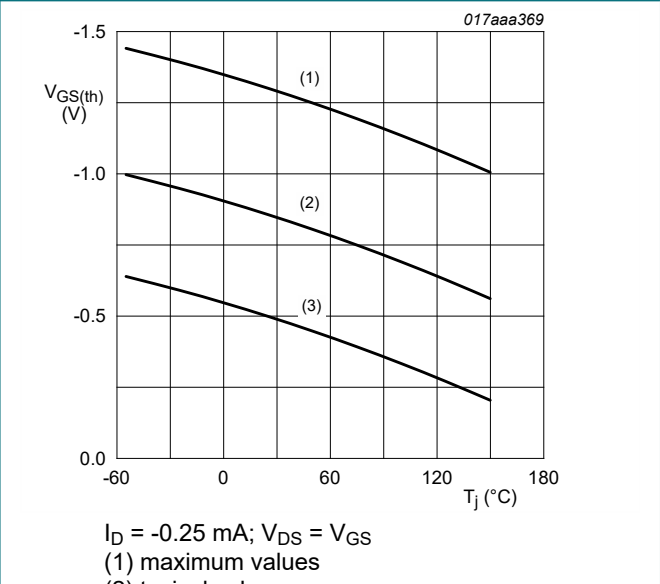
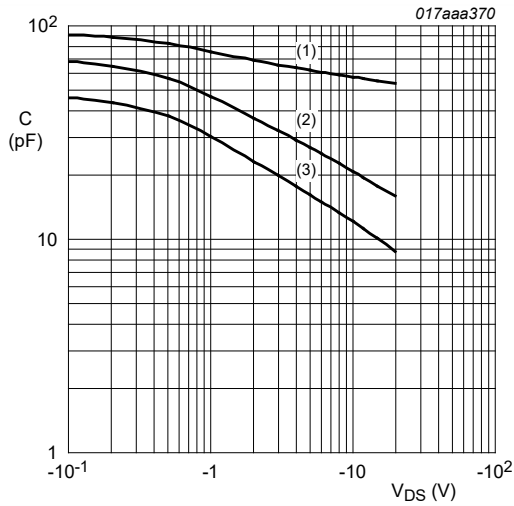


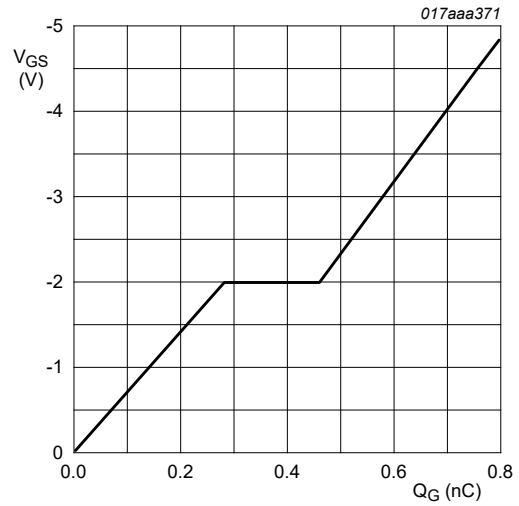
Fig. 26. TR2; Gate-source threshold voltage as a function of junction temperature



$f = 1 \text{ MHz}; V_{GS} = 0 \text{ V}$

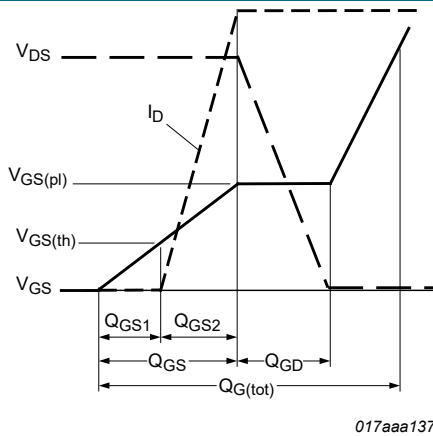
- (1)  $C_{iss}$
- (2)  $C_{oss}$
- (3)  $C_{rss}$

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

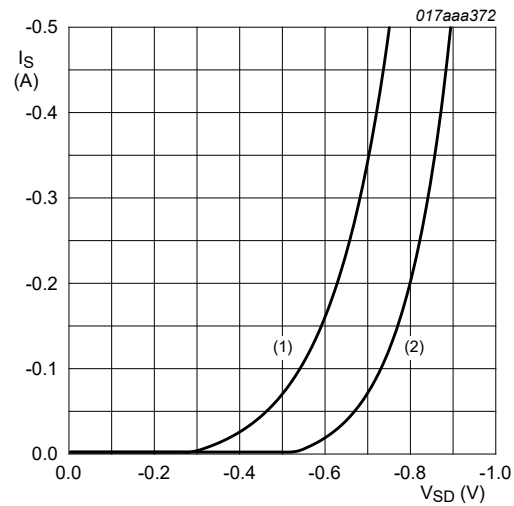


$I_D = -0.4 \text{ A}; V_{DD} = -10 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig. 28. TR2; Gate-source voltage as a function of gate charge; typical values**



**Fig. 29. Gate charge waveform definitions**



$V_{GS} = 0 \text{ V}$   
 (1)  $T_{amb} = 150 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$

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

### 11. Test information

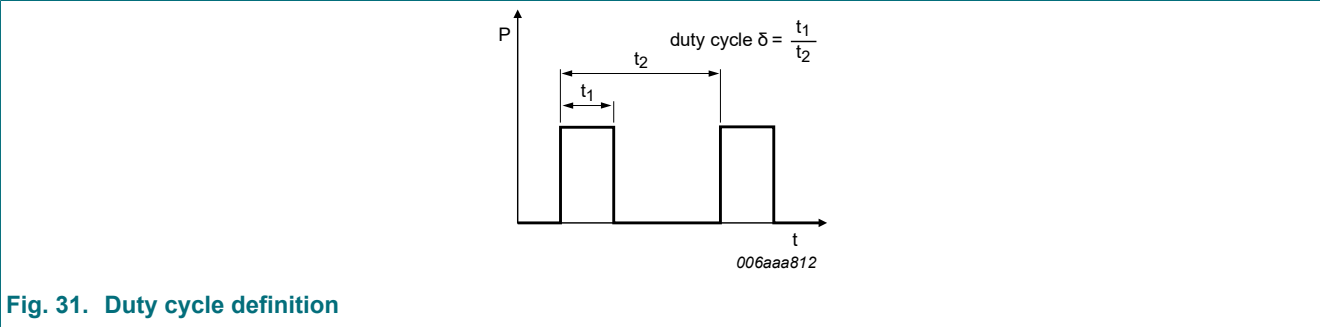


Fig. 31. Duty cycle definition

12. Package outline

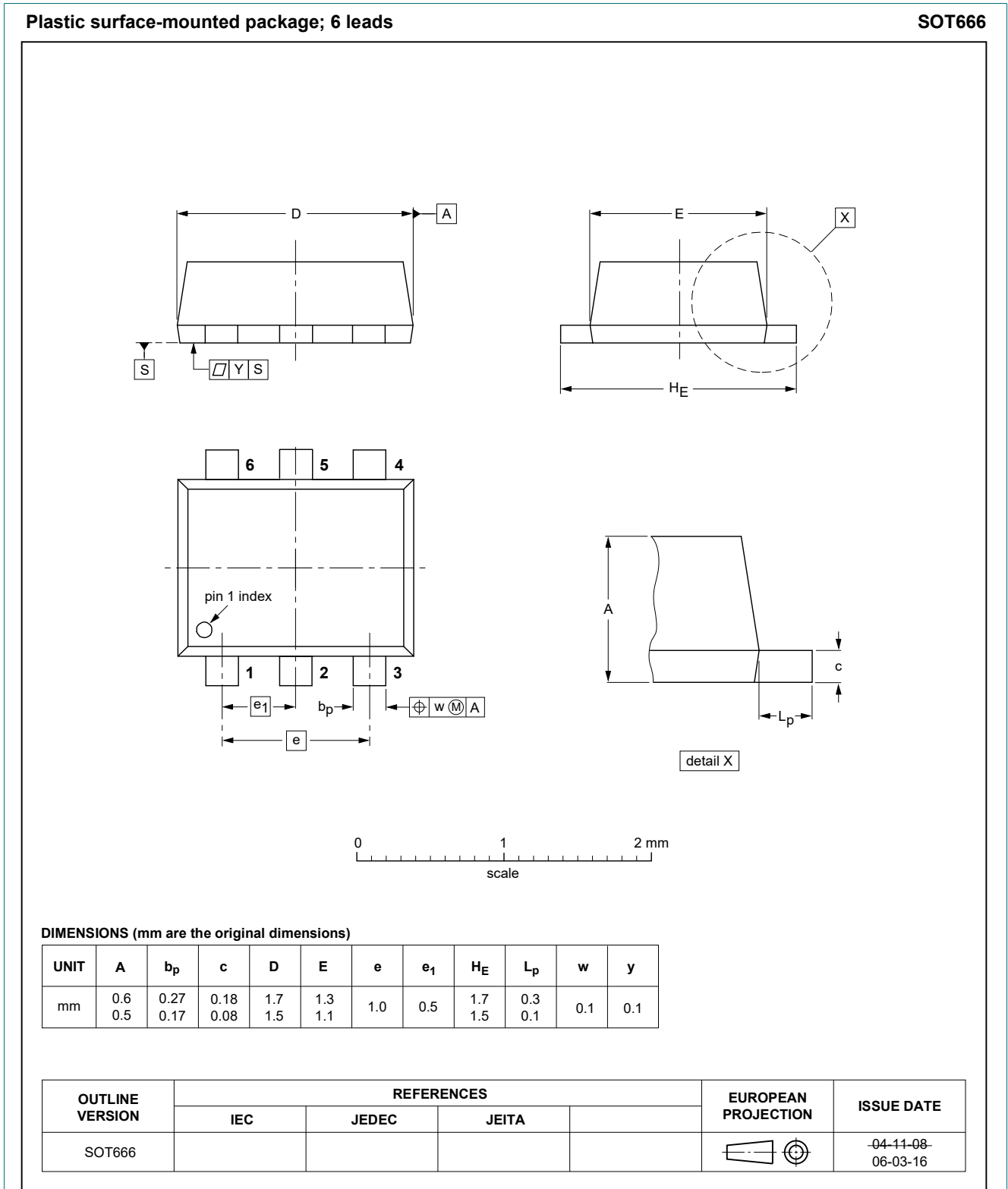


Fig. 32. Package outline SOT666



### 13. Soldering

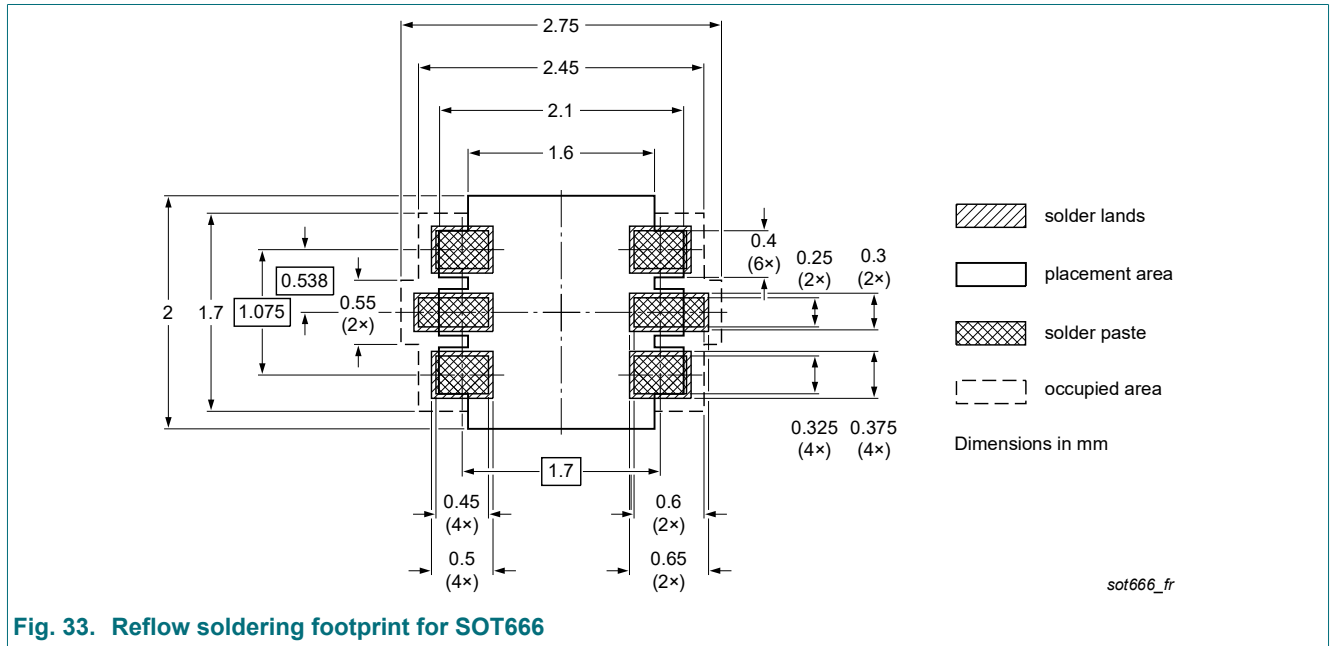


Fig. 33. Reflow soldering footprint for SOT666

## 14. Revision history

**Table 8. Revision history**

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMDT290UCE v.2	20221228	Product data sheet	-	PMDT290UCE v.1
Modifications:	<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia</li><li>• Legal texts have been adapted to the new company name where appropriate</li><li>• Product changed to non-automotive qualification</li></ul>			
PMDT290UCE v.1	20111006	Product data sheet	-	-

## 15. Legal information

### 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 <https://www.nexperia.com>.

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Date of release: 28 December 2022

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