PMGD290UCEA

20 / 20 V, 725 / 500 mA N/P-channel Trench MOSFET

28 March 2014 Product data sheet

1. General description

Complementary N/P-channel enhancement mode Field-Effect Transistor (FET) in a very small SOT363 Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Very fast switching
- Trench MOSFET technology
- 2 kV ESD protection
- AEC-Q101 qualified

3. Applications

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

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
TR1 (N-channel), Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 4.5 V; I_D = 500 mA; T_j = 25 °C		-	290	380	mΩ
TR2 (P-channel), Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = -4.5 V; I_D = -400 mA; T_j = 25 °C		-	670	850	mΩ
TR1 (N-channel)							
V_{DS}	drain-source voltage	T_j = 25 °C		-	-	20	V
V_{GS}	gate-source voltage			-8	-	8	V
I_D	drain current	V_{GS} = 4.5 V; T_{amb} = 25 °C	[1]	-	-	725	mA
TR2 (P-channel)							
V_{DS}	drain-source voltage	T_j = 25 °C		-	-	-20	V

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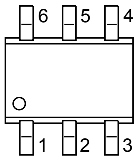
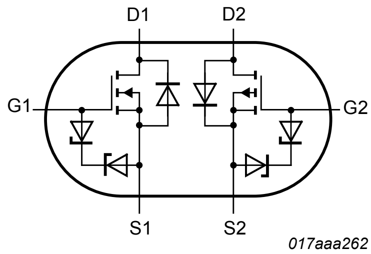
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{GS}	gate-source voltage			-8	-	8	V
I_D	drain current	V_{GS} = -4.5 V; T_{amb} = 25 °C	[1]	-	-	-500	mA

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

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source TR1	 TSSOP6 (SOT363)	
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
PMGD290UCEA	TSSOP6	plastic surface-mounted package; 6 leads	SOT363

7. Marking

Table 4. Marking codes

Type number	Marking code [1]
PMGD290UCEA	YD%

[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
TR1 (N-channel)						
V_{DS}	drain-source voltage	T_j = 25 °C		-	20	V
V_{GS}	gate-source voltage			-8	8	V

Symbol	Parameter	Conditions		Min	Max	Unit
I_D	drain current	V_{GS} = 4.5 V; T_{amb} = 25 °C	[1]	-	725	mA
		V_{GS} = 4.5 V; T_{amb} = 100 °C	[1]	-	450	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq 10$ µs		-	3	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	280	mW
			[1]	-	320	mW
		T_{sp} = 25 °C		-	990	mW
TR1 (N-channel), Source-drain diode						
I_S	source current	T_{amb} = 25 °C	[1]	-	370	mA
TR1 N-channel), ESD maximum rating						
V_{ESD}	electrostatic discharge voltage	HBM	[3]	-	2000	V
TR2 (P-channel)						
V_{DS}	drain-source voltage	T_j = 25 °C		-	-20	V
V_{GS}	gate-source voltage			-8	8	V
I_D	drain current	V_{GS} = -4.5 V; T_{amb} = 25 °C	[1]	-	-500	mA
		V_{GS} = -4.5 V; T_{amb} = 100 °C	[1]	-	-320	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq 10$ µs		-	-2	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	280	mW
			[1]	-	320	mW
		T_{sp} = 25 °C		-	990	mW
TR2 (P-channel), Source-drain diode						
I_S	source current	T_{amb} = 25 °C	[1]	-	-370	mA
TR2 (P-channel), ESD maximum rating						
V_{ESD}	electrostatic discharge voltage	HBM	[3]	-	2000	V
Per device						
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	445	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 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.

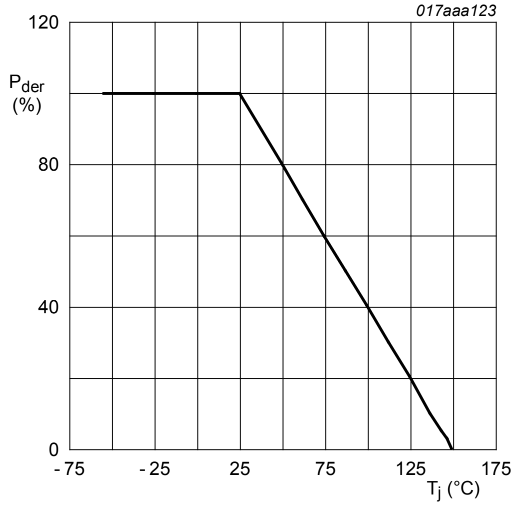


Fig. 1. **Normalized total power dissipation as a function of junction temperature**

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

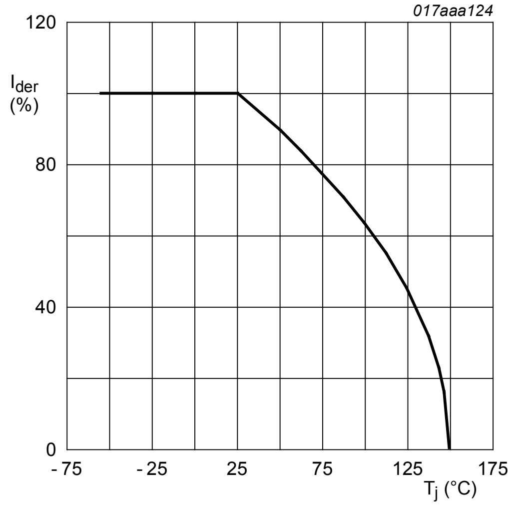
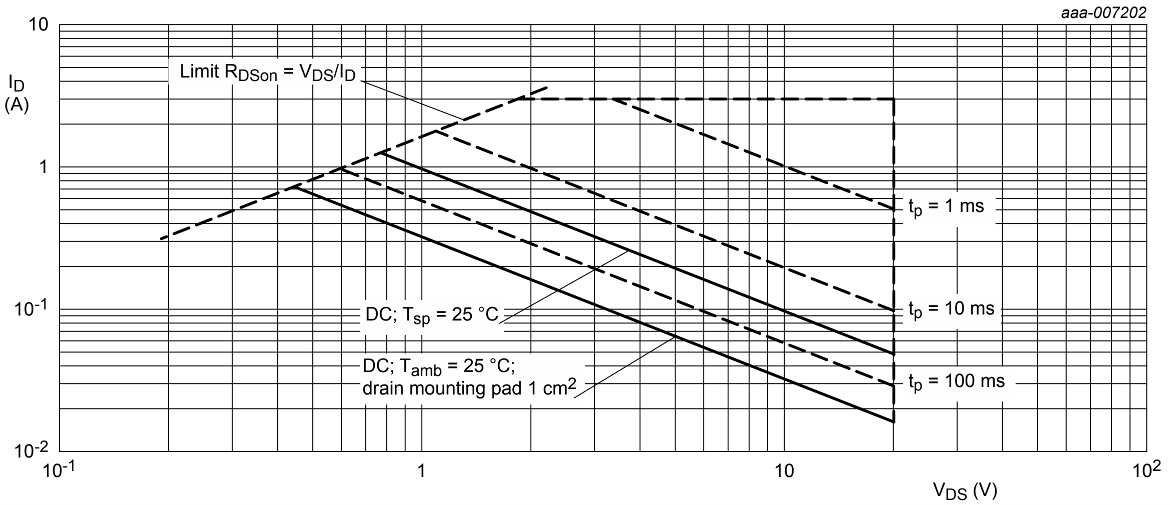


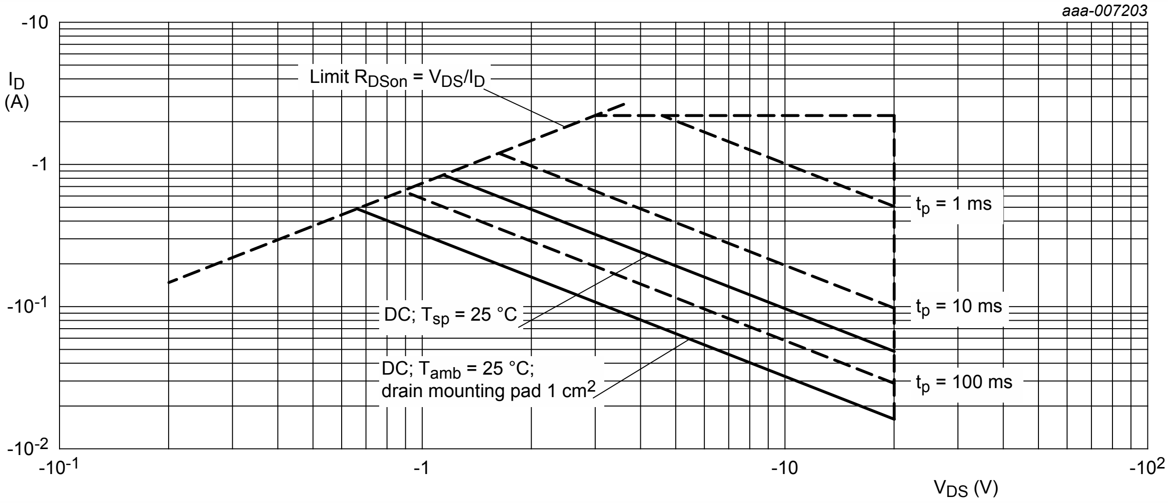
Fig. 2. **Normalized continuous drain current as a function of junction temperature**

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



I_{DM} = single pulse

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



I_{DM} = single pulse

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

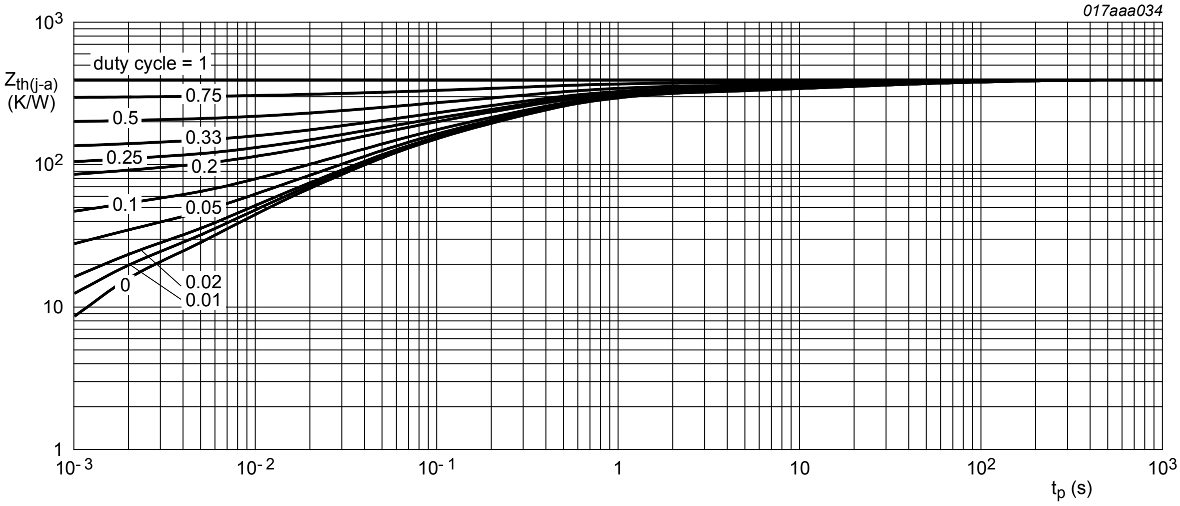
9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
TR1 (N-channel)							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	390	445	K/W
			[2]	-	340	390	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	130	K/W
TR2 (P-channel)							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	390	445	K/W
			[2]	-	340	390	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	130	K/W
Per device							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	300	K/W

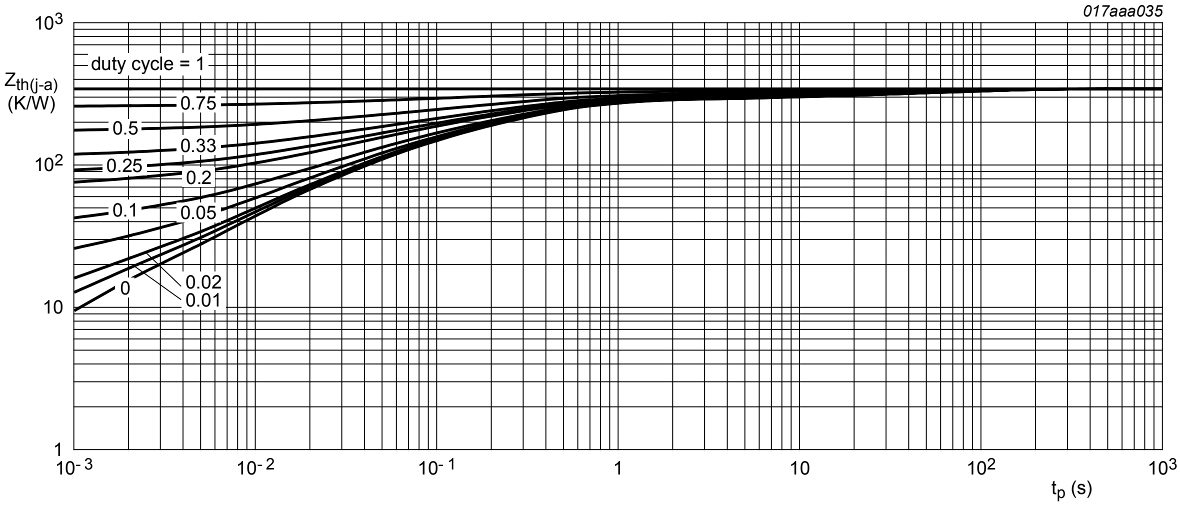
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper; tin-plated and standard footprint.

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



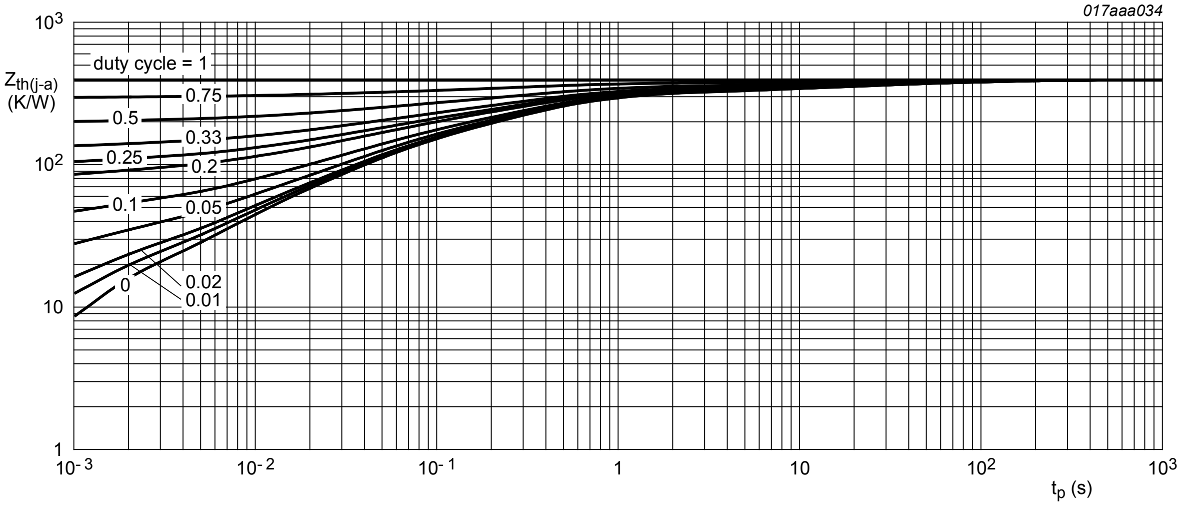
FR4 PCB, standard footprint

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



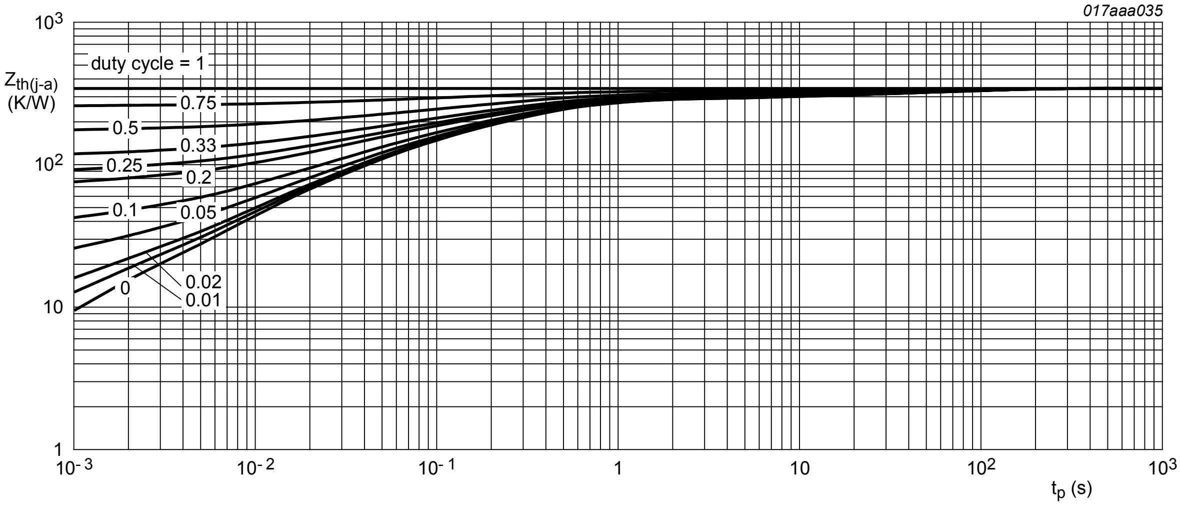
FR4 PCB, mounting pad for drain 1 cm^2.

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

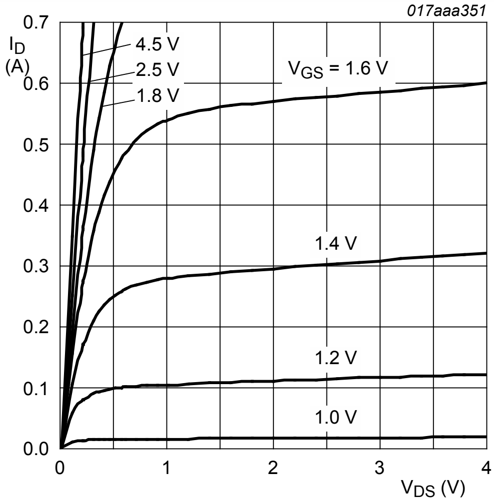
Fig. 8. TR2: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

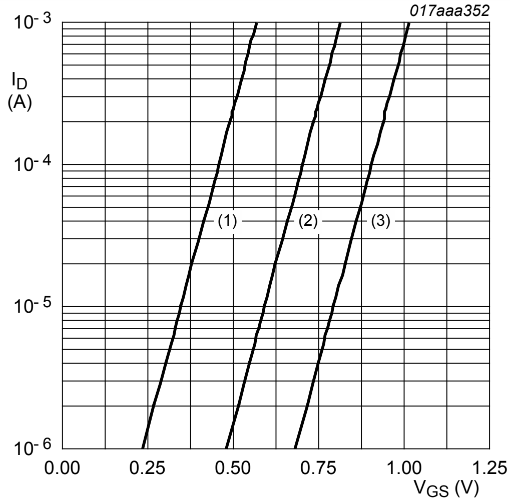
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
TR1 (N-channel), Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		20	-	-	V
V_{GSth}	gate-source threshold voltage	I_D = 250 µA; V_{DS} = V_{GS}; T_j = 25 °C		0.5	0.75	0.95	V
I_{DSS}	drain leakage current	V_{DS} = 20 V; V_{GS} = 0 V; T_j = 25 °C		-	-	1	µA
		V_{DS} = 20 V; V_{GS} = 0 V; T_j = 150 °C		-	-	10	µA
I_{GSS}	gate leakage current	V_{GS} = 8 V; V_{DS} = 0 V; -40 °C < T_j < 150 °C		-	-	10	µA
		V_{GS} = -8 V; V_{DS} = 0 V; -40 °C < T_j < 150 °C		-	-	-10	µA
R_{DSon}	drain-source on-state resistance	V_{GS} = 4.5 V; I_D = 500 mA; T_j = 25 °C		-	290	380	mΩ
		V_{GS} = 4.5 V; I_D = 500 mA; T_j = 150 °C		-	460	610	mΩ
		V_{GS} = 2.5 V; I_D = 200 mA; T_j = 25 °C		-	420	620	mΩ
		V_{GS} = 1.8 V; I_D = 10 mA; T_j = 25 °C		-	0.6	1.1	Ω
g_{fs}	transfer conductance	V_{DS} = 10 V; I_D = 200 mA; T_j = 25 °C		-	1.6	-	S
TR1 (N-channel), Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	V_{DS} = 10 V; I_D = 500 mA; V_{GS} = 4.5 V; T_j = 25 °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 MHz; V_{GS} = 0 V; T_j = 25 °C		-	55	83	pF
C_{oss}	output capacitance			-	15	-	pF
C_{rss}	reverse transfer capacitance			-	7	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 10 V; R_L = 250 Ω; V_{GS} = 4.5 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °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
TR1 (N-channel), Source-drain diode characteristics							
V_{SD}	source-drain voltage	I_S = 300 mA; V_{GS} = 0 V; T_j = 25 °C		0.48	0.77	1.2	V
TR2 (P-channel), Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = -250 µA; V_{GS} = 0 V; T_j = 25 °C		-20	-	-	V

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{GSth}	gate-source threshold voltage	I_D = -250 μA; V_{DS} = V_{GS}; T_j = 25 °C		-0.5	-0.8	-1.3	V
I_{DSS}	drain leakage current	V_{DS} = -20 V; V_{GS} = 0 V; T_j = 25 °C		-	-	-1	μA
		V_{DS} = -20 V; V_{GS} = 0 V; T_j = 150 °C		-	-	-10	μA
I_{GSS}	gate leakage current	V_{GS} = 8 V; V_{DS} = 0 V; -40 °C < T_j < 150 °C		-	-	10	μA
		V_{GS} = -8 V; V_{DS} = 0 V; -40 °C < T_j < 150 °C		-	-	-10	μA
R_{DSon}	drain-source on-state resistance	V_{GS} = -4.5 V; I_D = -400 mA; T_j = 25 °C		-	670	850	mΩ
		V_{GS} = -4.5 V; I_D = -400 mA; T_j = 150 °C		-	1.1	1.4	Ω
		V_{GS} = -2.5 V; I_D = -200 mA; T_j = 25 °C		-	1.2	1.5	Ω
		V_{GS} = -1.8 V; I_D = -10 mA; T_j = 25 °C		-	1.8	2.8	Ω
g_{fs}	transfer conductance	V_{DS} = -10 V; I_D = -200 mA; T_j = 25 °C		-	610	-	mS
TR2 (P-channel), Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	V_{DS} = -10 V; I_D = -400 mA; V_{GS} = -4.5 V; T_j = 25 °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 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °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 V; R_L = 250 Ω; V_{GS} = -4.5 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °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
TR2 (P-channel), Source-drain diode characteristics							
V_{SD}	source-drain voltage	I_S = -300 mA; V_{GS} = 0 V; T_j = 25 °C		-0.48	-0.84	-1.2	V



T_j = 25 °C

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



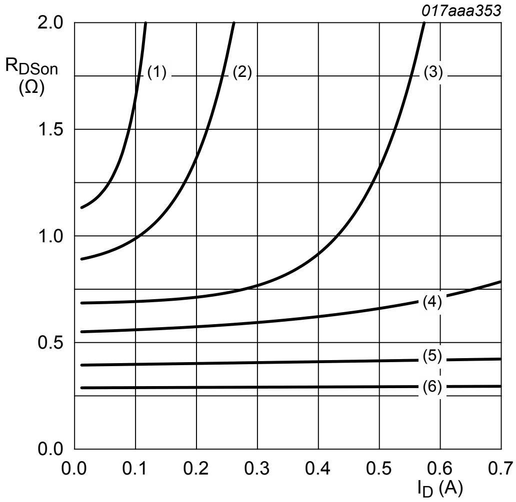
T_j = 25 °C; V_{DS} = 5 V

(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} = 1.3 V

(2) V_{GS} = 1.4 V

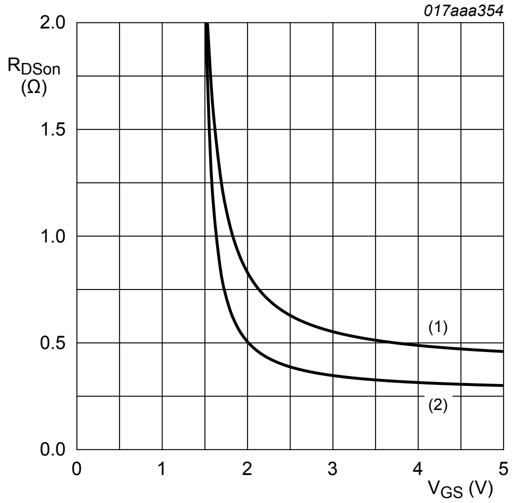
(3) V_{GS} = 1.6 V

(4) V_{GS} = 1.8 V

(5) V_{GS} = 2.5 V

(6) V_{GS} = 4.5 V

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

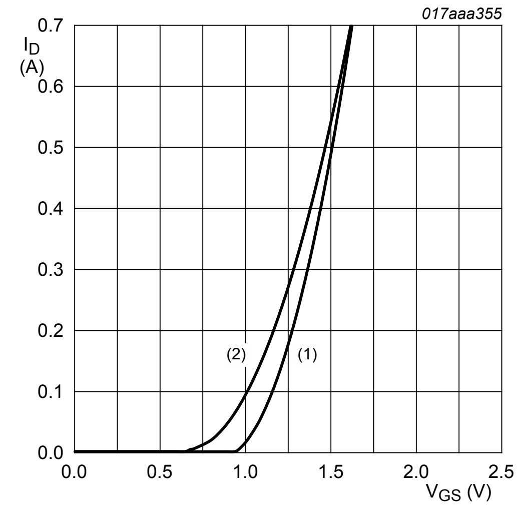


I_D = 400 mA

(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



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

(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

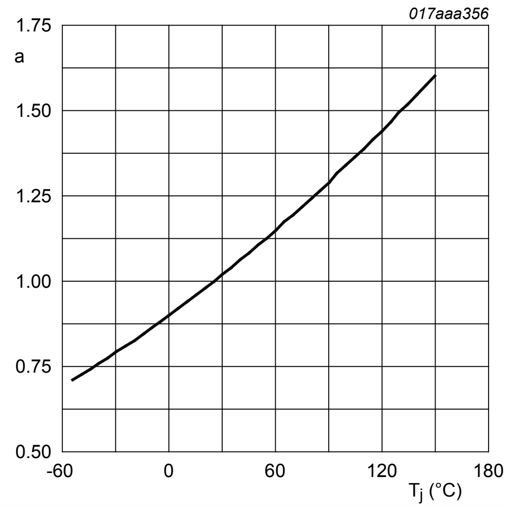
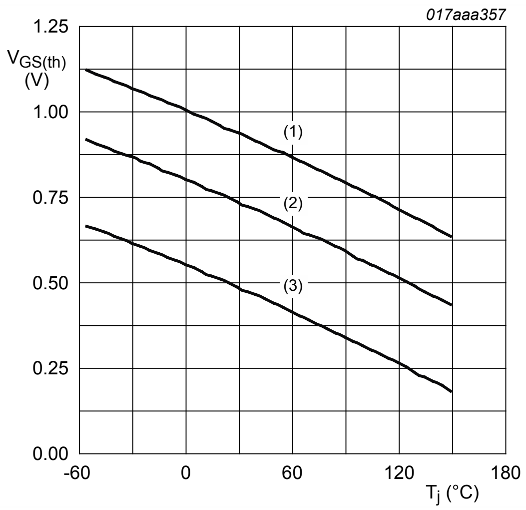


Fig. 14. TR1; Normalized drain-source on-state resistance as a function of junction temperature; typical values

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



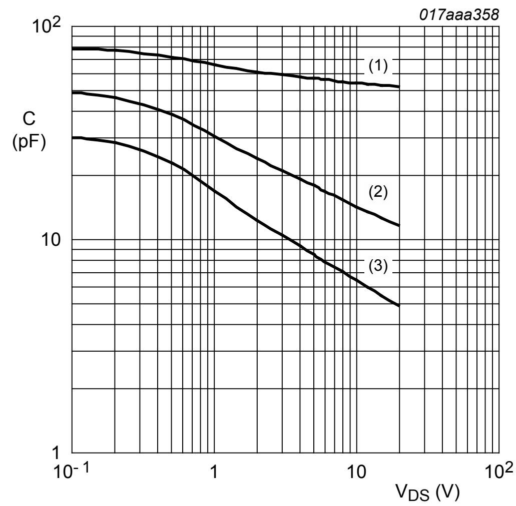
I_D = 0.25 mA; $V_{DS} = V_{GS}$

(1) maximum values

(2) typical values

(3) minimum values

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



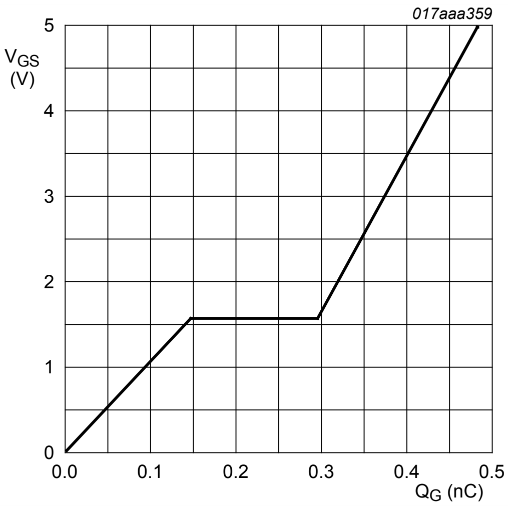
f = 1 MHz; V_{GS} = 0 V

(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 = 0.5 A; V_{DS} = 10 V; T_{amb} = 25 °C

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

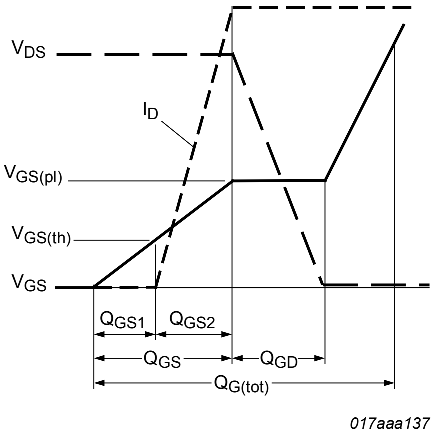
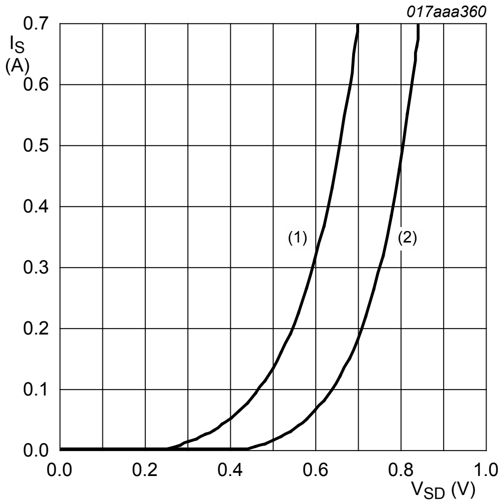


Fig. 18. Gate charge waveform definitions

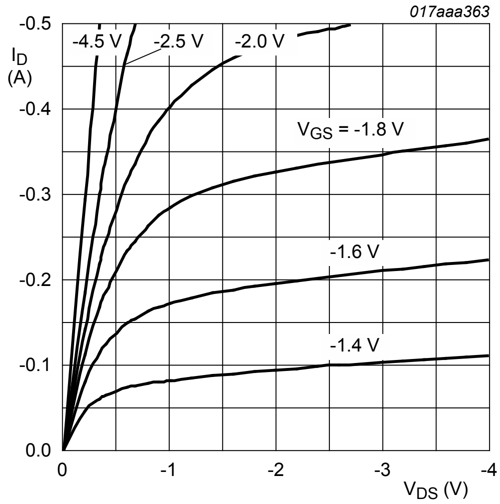


V_{GS} = 0 V

(1) T_j = 150 °C

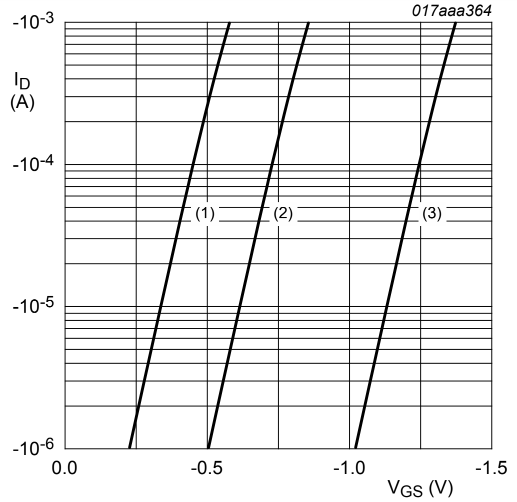
(2) T_j = 25 °C

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



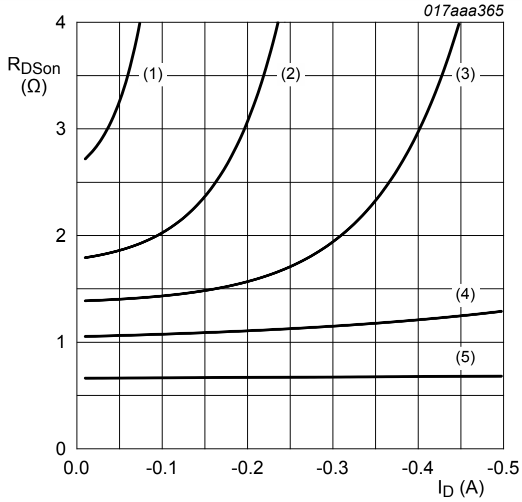
T_j = 25 °C; V_{DS} = -5 V

(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} = -1.5 V

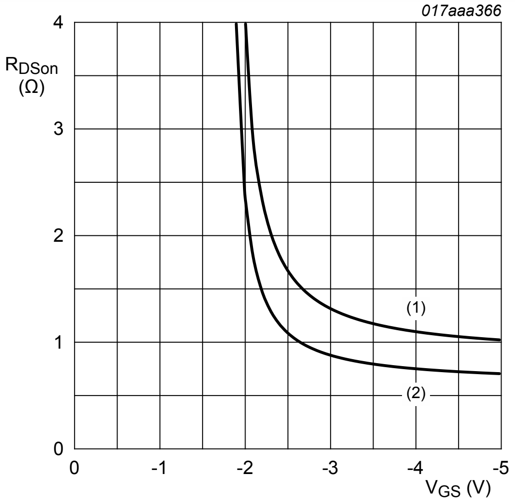
(2) V_{GS} = -1.8 V

(3) V_{GS} = -2.0 V

(4) V_{GS} = -2.5 V

(5) V_{GS} = -4.5 V

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

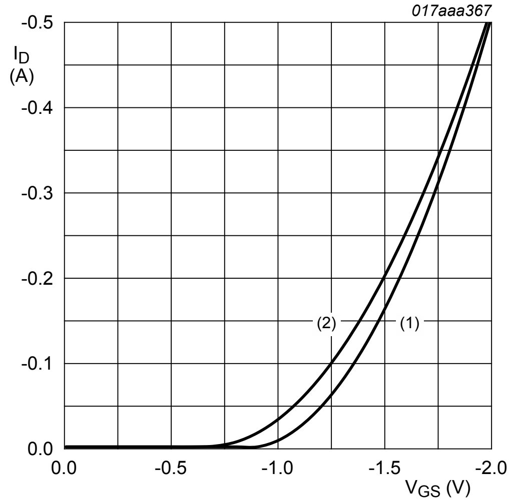


I_D = -400 mA

(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

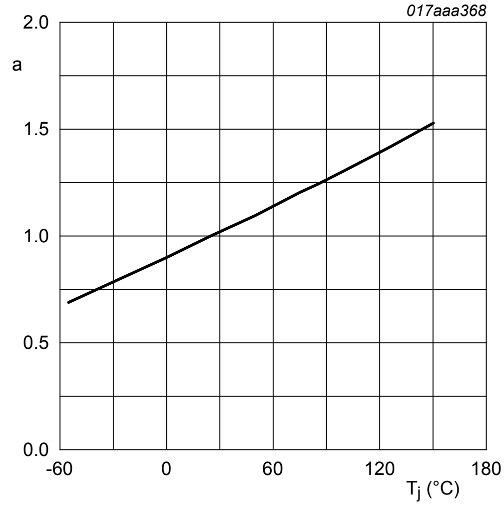
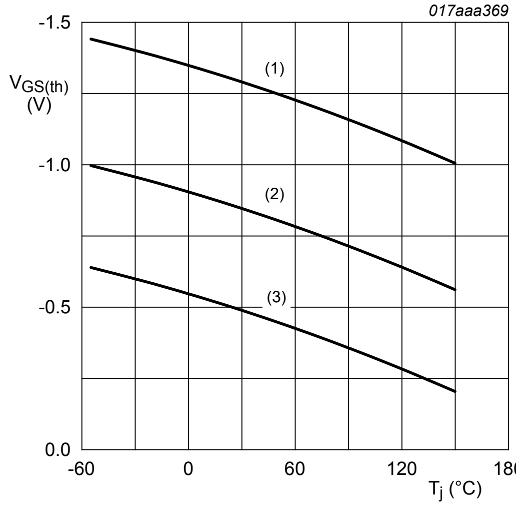


Fig. 25. TR2; Normalized drain-source on-state resistance as a function of ambient temperature; typical values

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



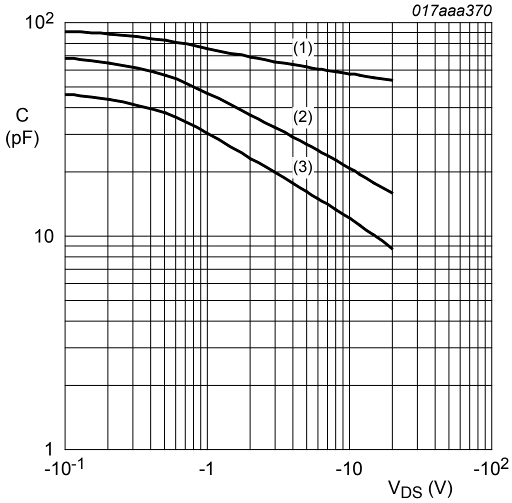
I_D = -0.25 mA; V_{DS} = V_{GS}

(1) maximum values

(2) typical values

(3) minimum values

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



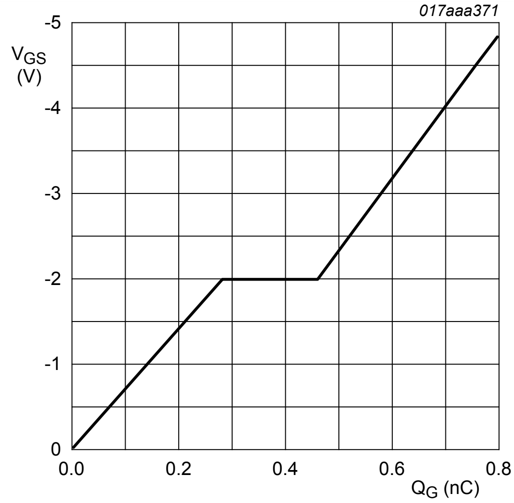
f = 1 MHz; V_{GS} = 0 V

(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 A; V_{DD} = -10 V; T_{amb} = 25 °C

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

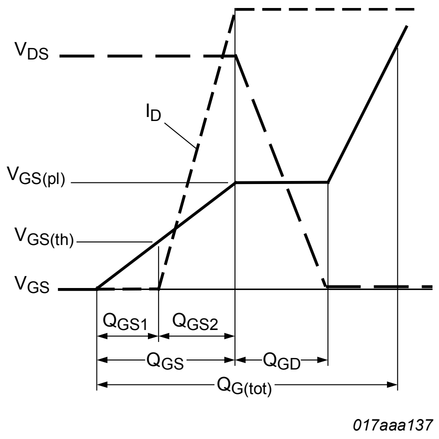
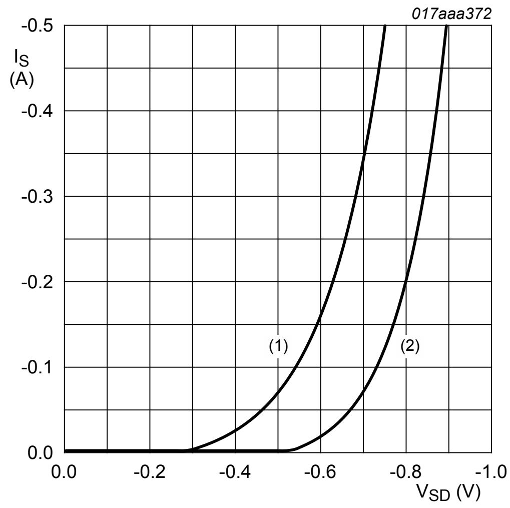


Fig. 29. Gate charge waveform definitions



V_{GS} = 0 V

(1) T_{amb} = 150 °C

(2) T_{amb} = 25 °C

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

11. Test information

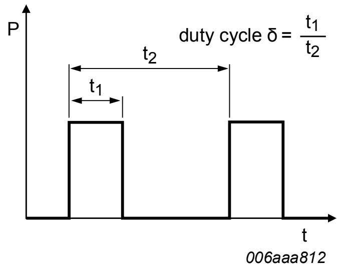


Fig. 31. Duty cycle definition

11.1 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.

12. Package outline

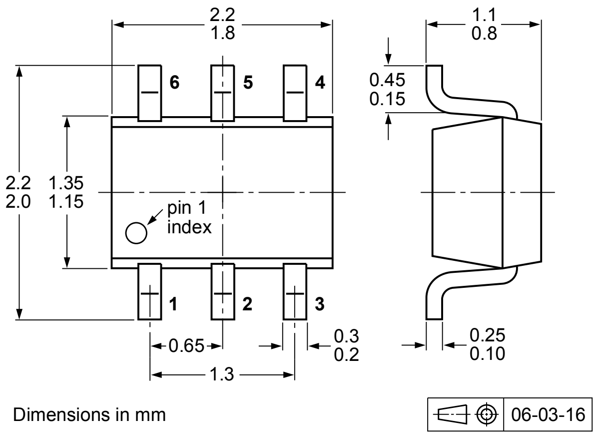


Fig. 32. Package outline TSSOP6 (SOT363)

13. Soldering

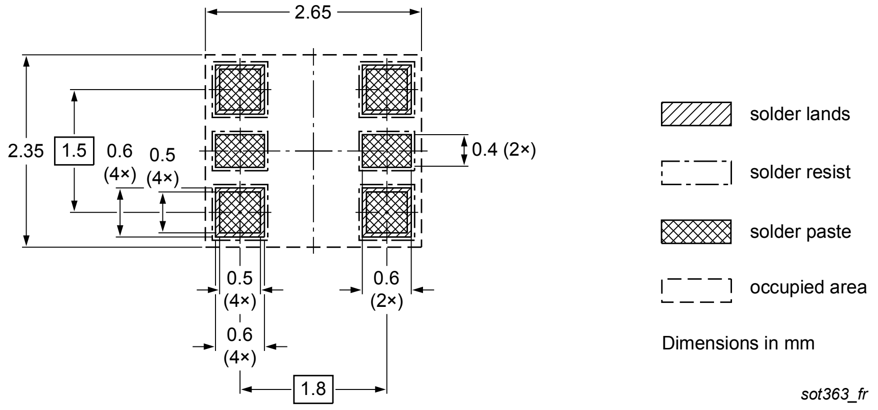


Fig. 33. Reflow soldering footprint for TSSOP6 (SOT363)

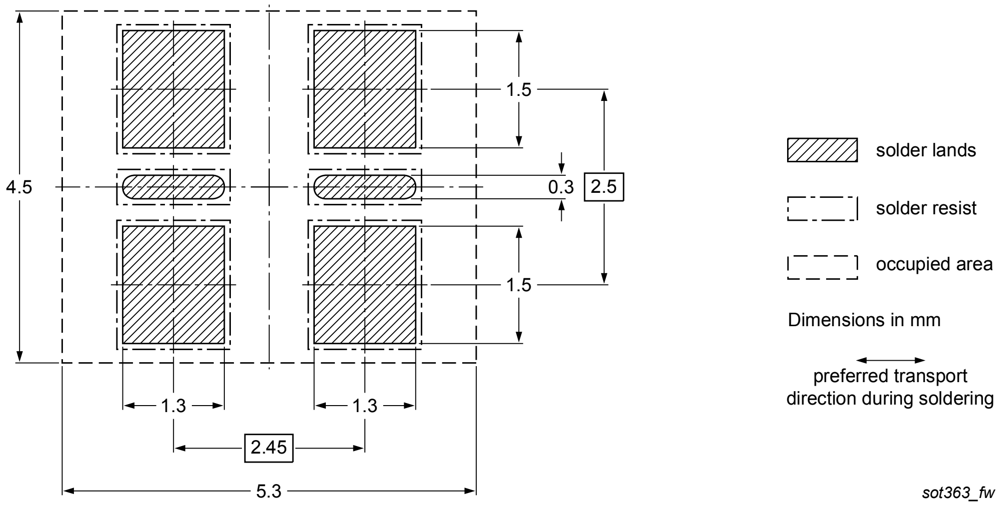


Fig. 34. Wave soldering footprint for TSSOP6 (SOT363)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMGD290UCEA v.3	20140328	Product data sheet	-	PMGD290UCEA v.2
Modifications:	• Table 7: I_{GSS} parameter unit corrected			
PMGD290UCEA v.2	20130418	Product data sheet	-	PMGD290UCEA v.1
PMGD290UCEA v.1	20130415	Product data sheet	-	-

15. Legal information

15.1 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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16. Contents

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Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.