



PMCM950ENE

60 V, N-channel Trench MOSFET

13 May 2019

Product data sheet

1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in a 9 bumps Wafer Level Chip-Size Package (WLCSP) using Trench MOSFET technology.

2. Features and benefits

- Low threshold voltage
- Ultra small package: 1.48 × 1.48 × 0.35 mm
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection > 2 kV HBM

3. Applications

- High-speed line driver
- Low-side load switch
- Switching circuits

4. Quick reference data

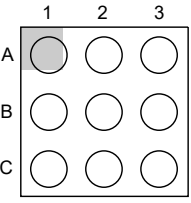
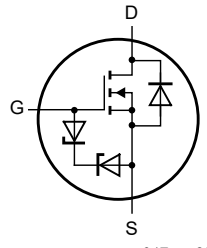
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j = 25\text{ °C}$	-	-	60	V
V_{GS}	gate-source voltage		-20	-	20	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}; t \leq 5\text{ s}$	[1]	-	6.1	A
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 3\text{ A}; T_j = 25\text{ °C}$	-	28	41	mΩ

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm².

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
A1	G	gate	 <p>Transparent top view WLCSP9 (WLCSP9_3x3)</p>	 <p>017aaa255</p>
A2	S	source		
A3	S	source		
B1	S	source		
B2	S	source		
B3	S	source		
C1	D	drain		
C2	D	drain		
C3	D	drain		

6. Ordering information

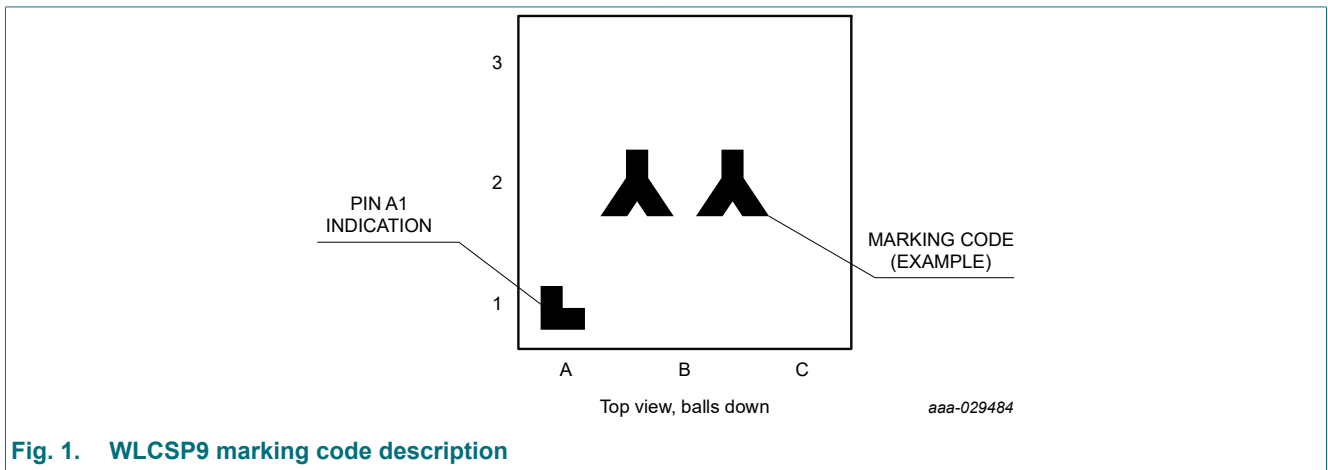
Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMCM950ENE	WLCSP9	WLCSP9: wafer level chip-size package; 9 bumps (3 x 3)	WLCSP9_3x3

7. Marking

Table 4. Marking codes

Type number	Marking code
PMCM950ENE	A1



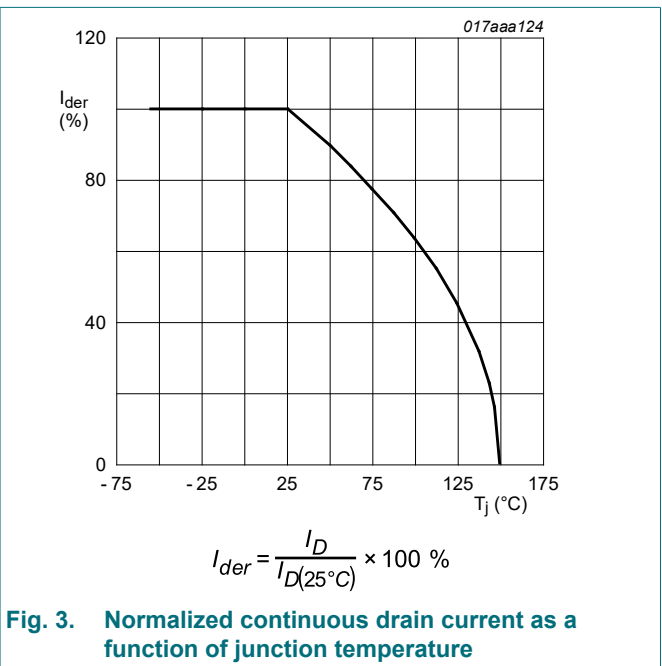
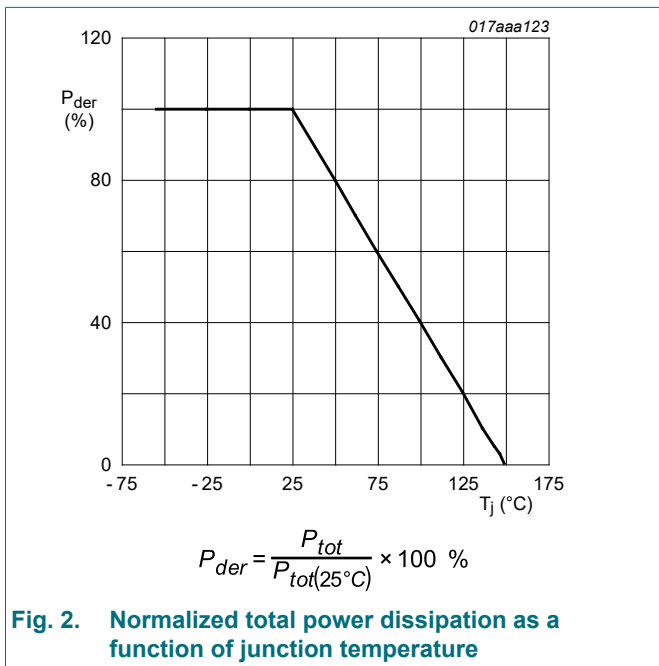
8. Limiting values

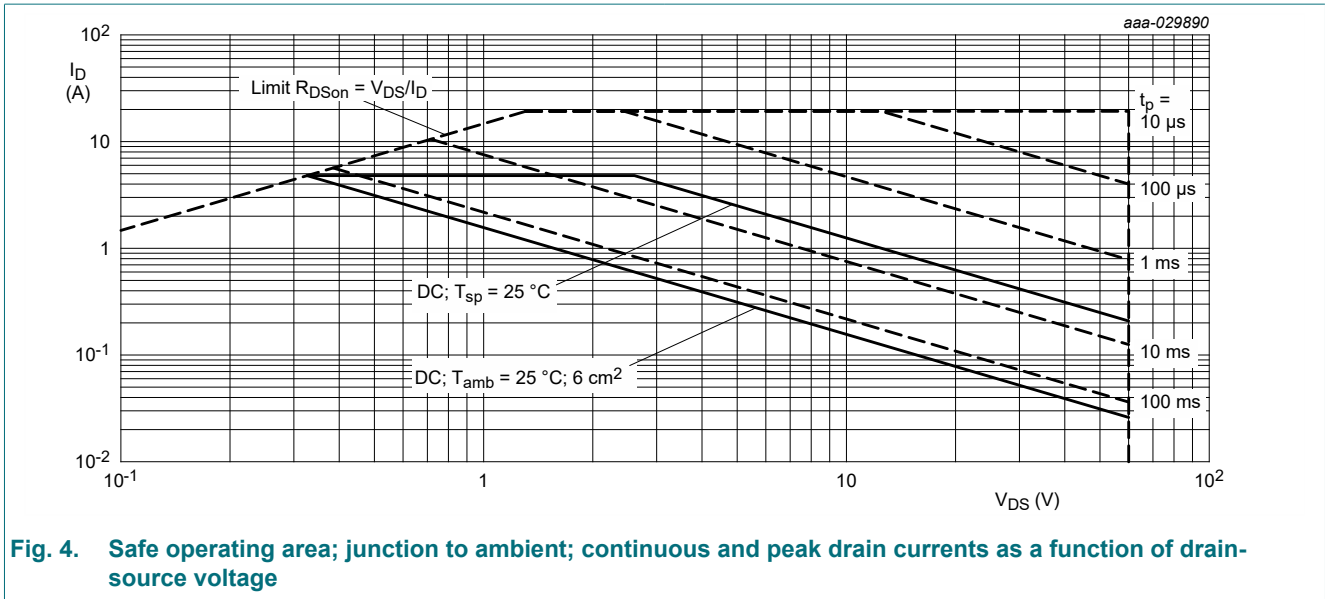
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V _{DS}	drain-source voltage	T _j = 25 °C		-	60	V
V _{GS}	gate-source voltage			-20	20	V
I _D	drain current	V _{GS} = 10 V; T _{amb} = 25 °C; t ≤ 5 s	[1]	-	6.1	A
		V _{GS} = 10 V; T _{amb} = 25 °C	[1]	-	4.8	A
		V _{GS} = 10 V; T _{amb} = 100 °C	[1]	-	3	A
I _{DM}	peak drain current	T _{amb} = 25 °C; single pulse; t _p ≤ 10 μs		-	19	A
P _{tot}	total power dissipation	T _{amb} = 25 °C	[2]	-	780	mW
			[1]	-	1.4	W
		T _{sp} = 25 °C		-	12.5	W
T _j	junction temperature			-55	150	°C
T _{amb}	ambient temperature			-55	150	°C
T _{stg}	storage temperature			-65	150	°C
Source Drain Diode						
I _S	source current	T _{amb} = 25 °C	[1]	-	1.4	A

- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm².
- [2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.





9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	130	160	K/W
			[2]	-	50	60	K/W
			[3]	-	65	80	K/W
		$t \leq 5$ s	[3]	-	42	50	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	5	10	K/W

- [1] Device mounted on an FR4 PCB, single sided-copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain, 4 layer, 1 cm².
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain 6 cm².

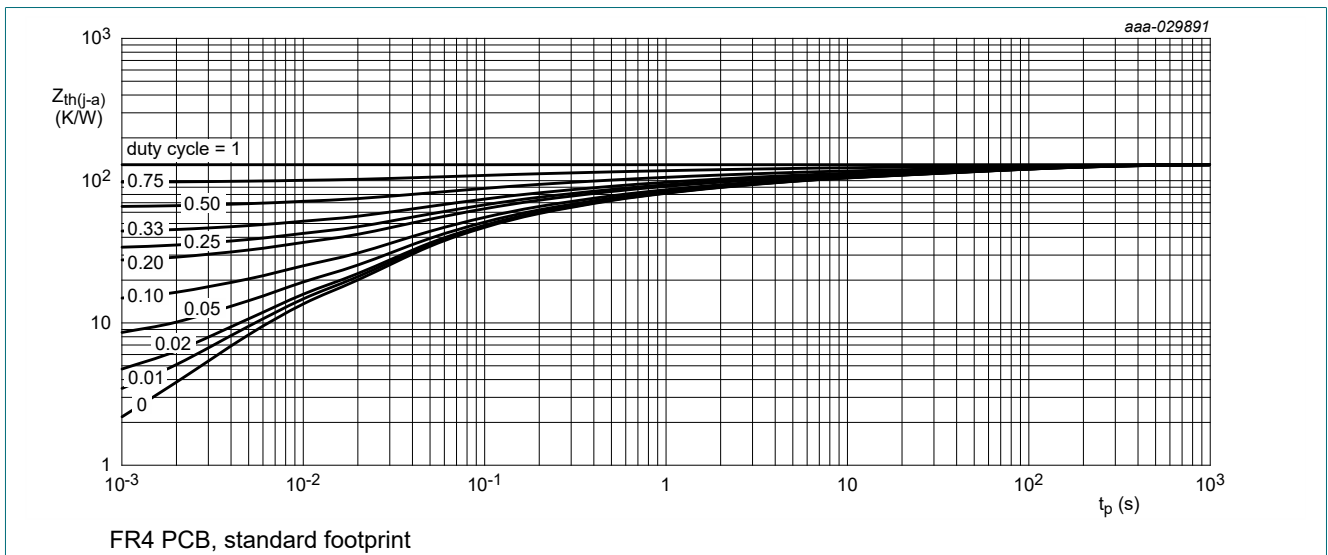


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

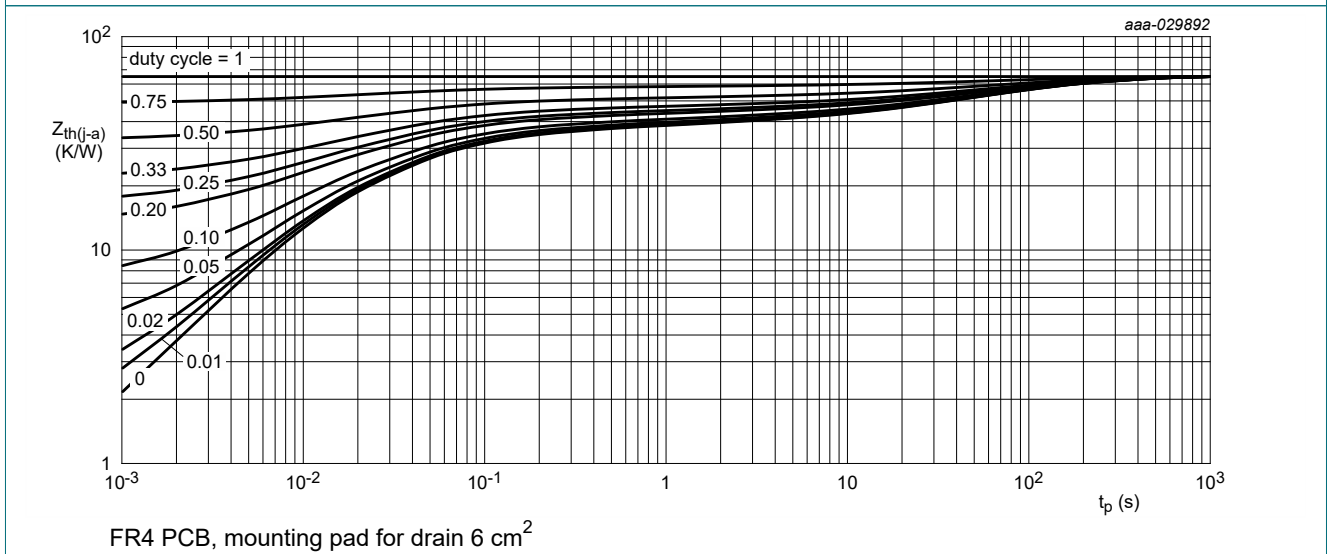


Fig. 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	60	-	-	V
V_{GSth}	gate-source threshold voltage	$I_D = 250 \mu\text{A}$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ }^\circ\text{C}$	0.9	1.2	1.5	V
I_{DSS}	drain leakage current	$V_{DS} = 60 \text{ V}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	1	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	10	μA
		$V_{GS} = -20 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-10	μA
		$V_{GS} = 8 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	1	μA
		$V_{GS} = -8 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-1	μA
		$V_{GS} = 4.5 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	200	nA
		$V_{GS} = -4.5 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-200	nA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 \text{ V}$; $I_D = 3 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$	-	28	41	m Ω
		$V_{GS} = 10 \text{ V}$; $I_D = 3 \text{ A}$; $T_j = 150 \text{ }^\circ\text{C}$	-	46	68	m Ω
		$V_{GS} = 4.5 \text{ V}$; $I_D = 3 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$	-	31	47	m Ω
g_{fs}	forward transconductance	$V_{DS} = 5 \text{ V}$; $I_D = 3 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$	-	20	-	S
R_G	gate resistance	$f = 1 \text{ MHz}$	-	5.7	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 \text{ V}$; $I_D = 3 \text{ A}$; $V_{GS} = 10 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	30	45	nC
Q_{GS}	gate-source charge		-	2.3	-	nC
Q_{GD}	gate-drain charge		-	5.9	-	nC
C_{iss}	input capacitance	$V_{DS} = 30 \text{ V}$; $f = 1 \text{ MHz}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	1160	-	pF
C_{oss}	output capacitance		-	71	-	pF
C_{rss}	reverse transfer capacitance		-	62	-	pF
$t_{d(on)}$	turn-on delay time		$V_{DS} = 30 \text{ V}$; $I_D = 3 \text{ A}$; $V_{GS} = 10 \text{ V}$; $R_{G(ext)} = 6 \text{ } \Omega$; $T_j = 25 \text{ }^\circ\text{C}$	-	2	-
t_r	rise time	-		4	-	ns
$t_{d(off)}$	turn-off delay time	-		70	-	ns
t_f	fall time	-		17	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 1.4 \text{ A}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	0.7	1.2	V

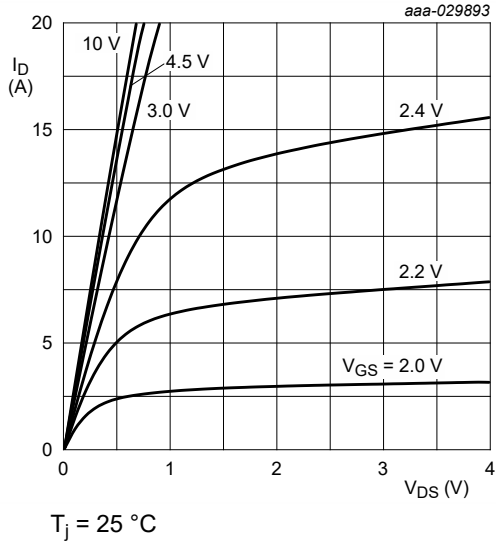


Fig. 7. Output characteristics: drain current as a function of drain-source voltage; typical values

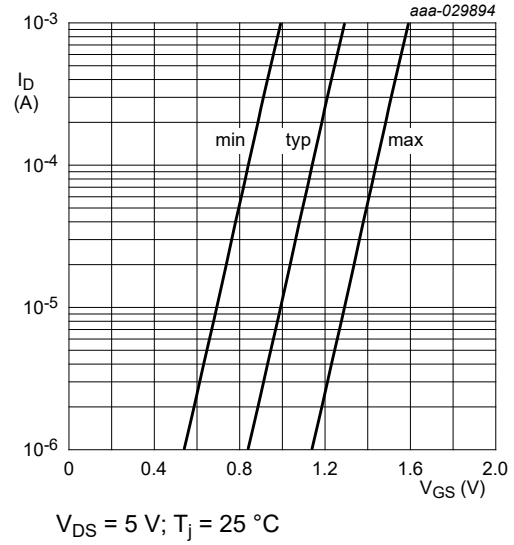


Fig. 8. Sub-threshold drain current as a function of gate-source voltage

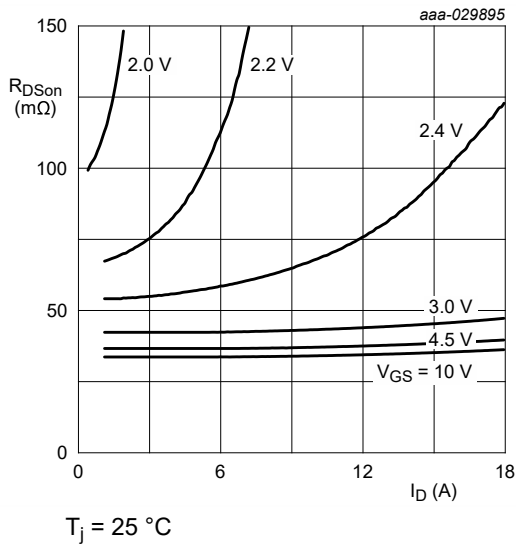


Fig. 9. Drain-source on-state resistance as a function of drain current; typical values

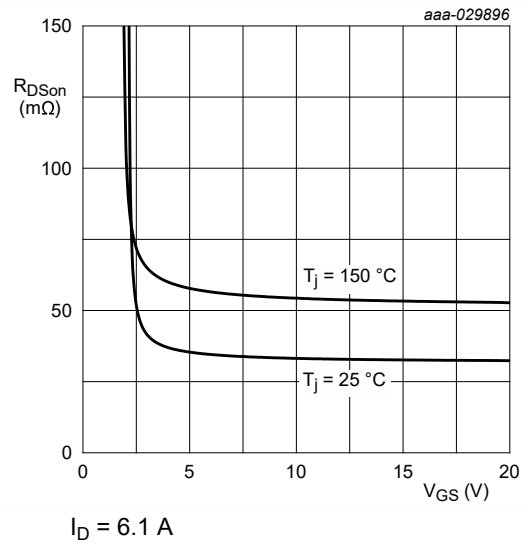
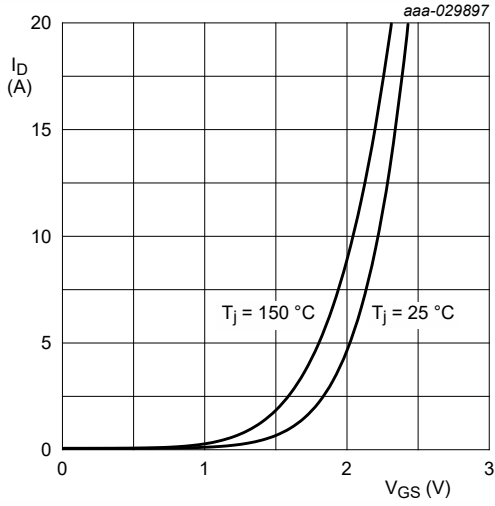
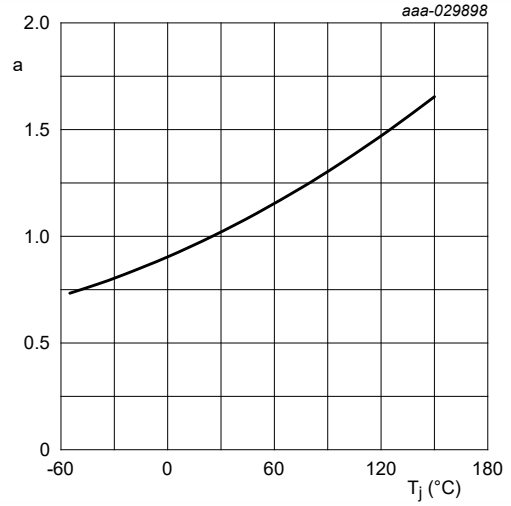


Fig. 10. Drain-source on-state resistance as a function of gate-source voltage; typical values



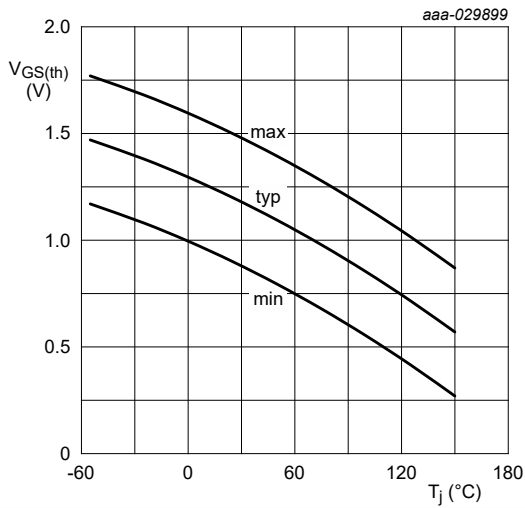
$$V_{DS} > I_D \times R_{DSon}$$

Fig. 11. Transfer characteristics: drain current as a function of gate-source voltage; typical values



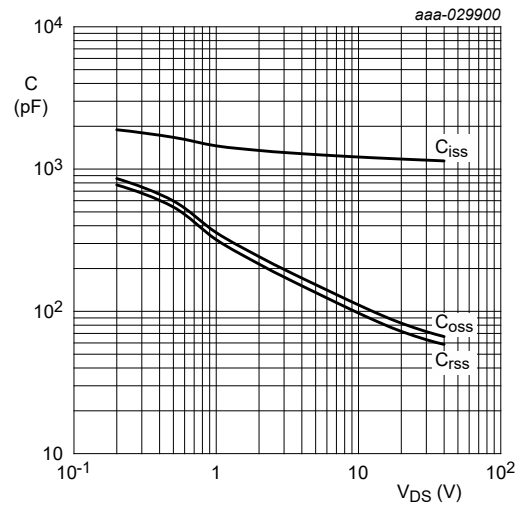
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

Fig. 12. Normalized drain-source on-state resistance as a function of junction temperature; typical values



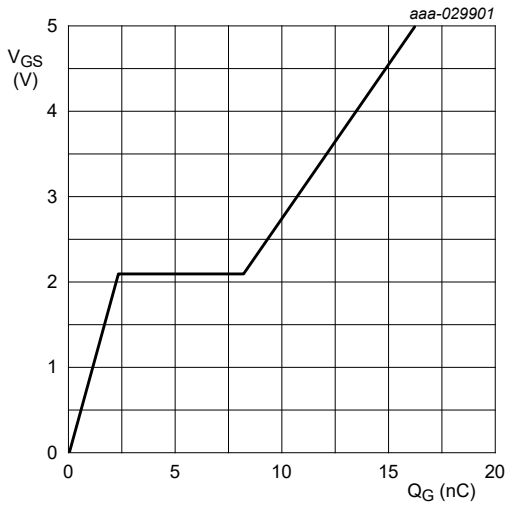
$$I_D = 250 \mu A; V_{DS} = V_{GS}$$

Fig. 13. Gate-source threshold voltage as a function of junction temperature



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

Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$V_{DS} = 30\text{ V}; I_D = 3\text{ A}; T_{amb} = 25\text{ }^\circ\text{C}$

Fig. 15. Gate-source voltage as a function of gate charge; typical values

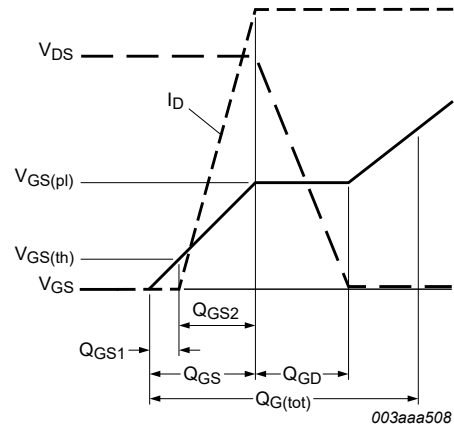
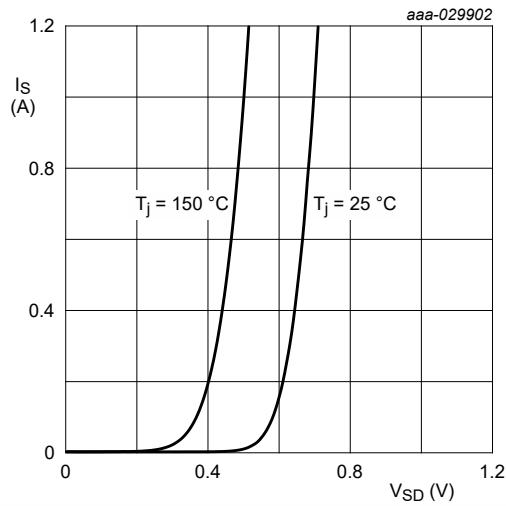


Fig. 16. Gate charge waveform definitions



$V_{GS} = 0\text{ V}$

Fig. 17. Source current as a function of source-drain voltage; typical values

11. Test information

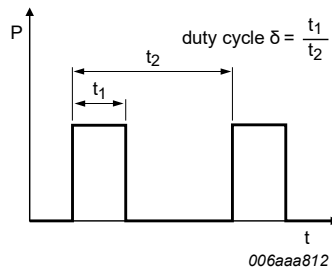


Fig. 18. Duty cycle definition

12. Package outline

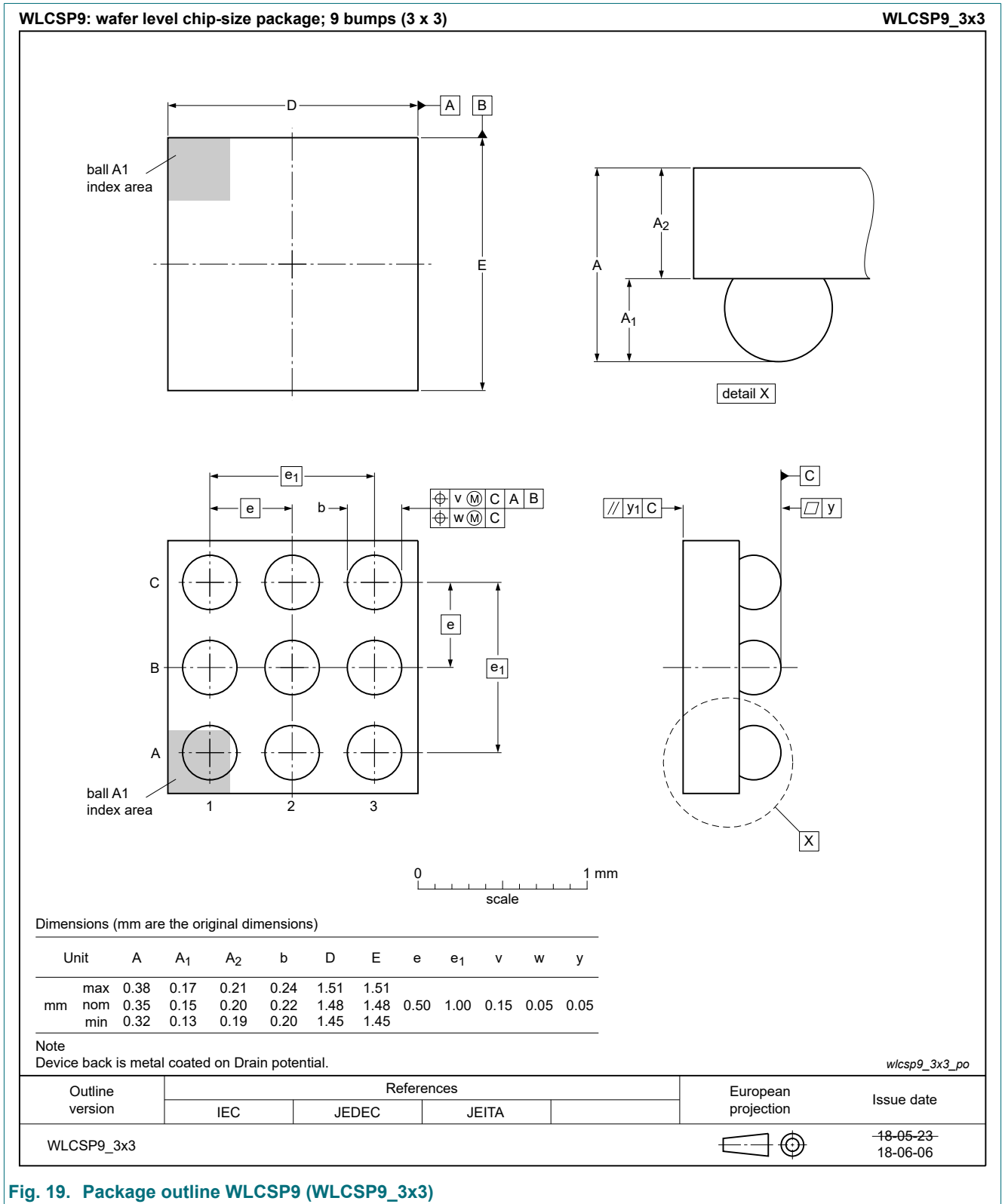


Fig. 19. Package outline WLCSP9 (WLCSP9_3x3)

13. Soldering

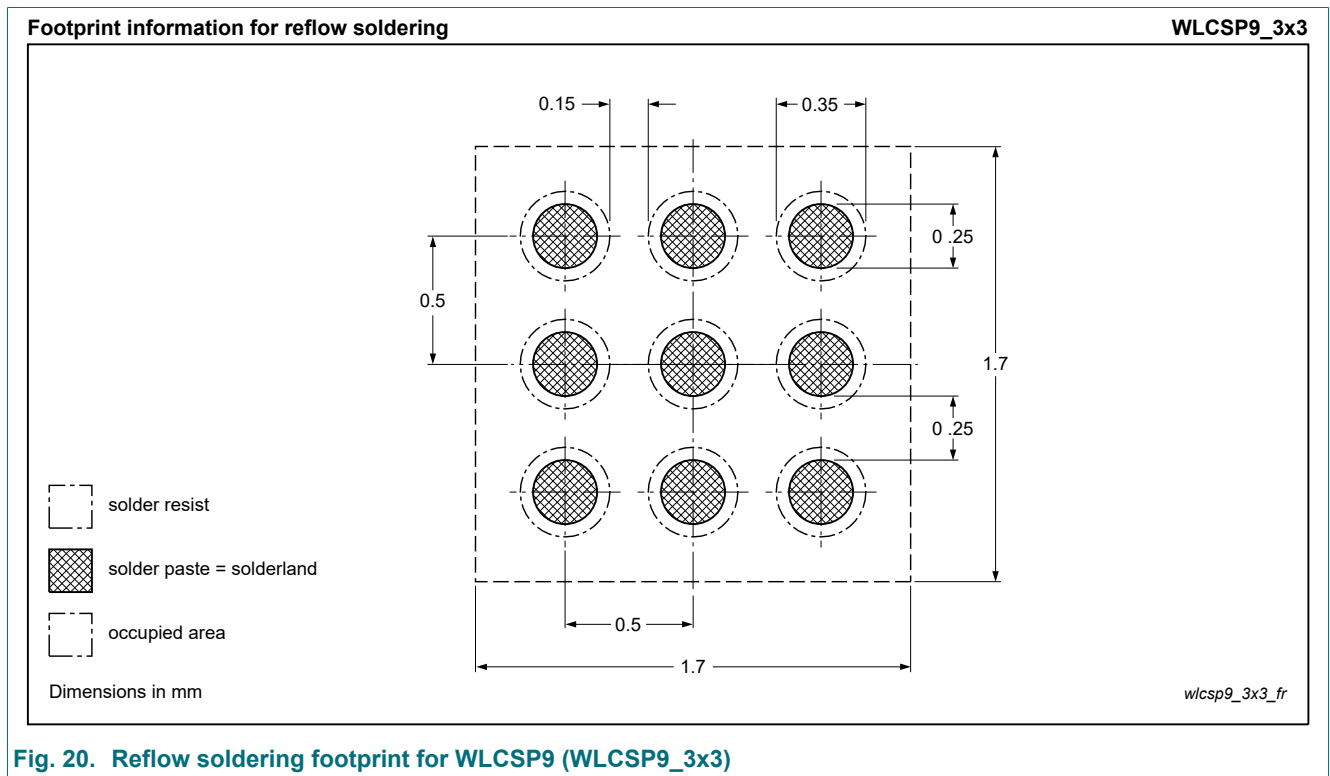


Fig. 20. Reflow soldering footprint for WLCSP9 (WLCSP9_3x3)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMCM950ENE v.1	20190513	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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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