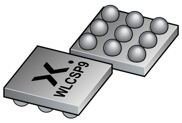


PMCM950ENE

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

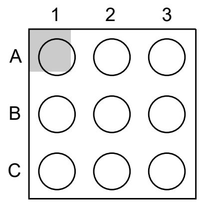
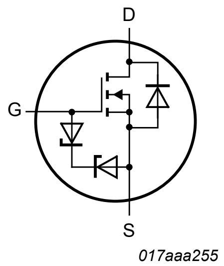
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	T_j = 25 °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
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 3 A; T_j = 25 °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 cm^2.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
A1	G	gate	 Transparent top view **WLCSP9 (WLCSP9_3x3)**	
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

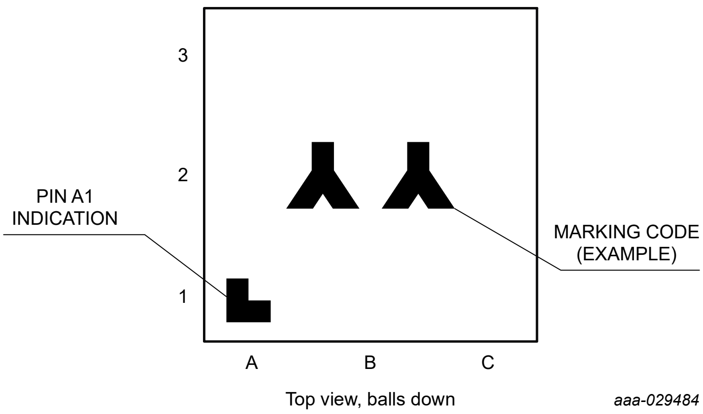


Fig. 1. WLCSP9 marking code description

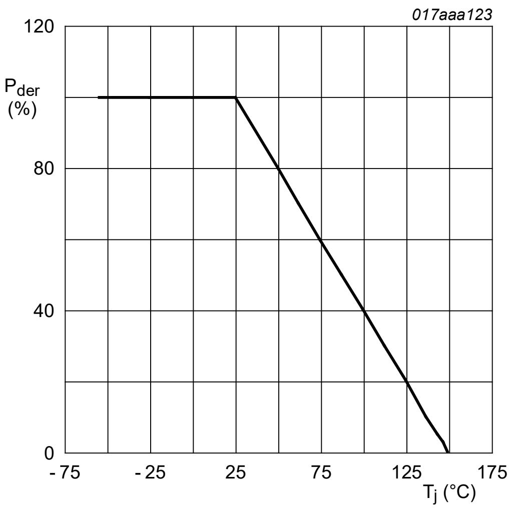
8. Limiting values

Table 5. Limiting values

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

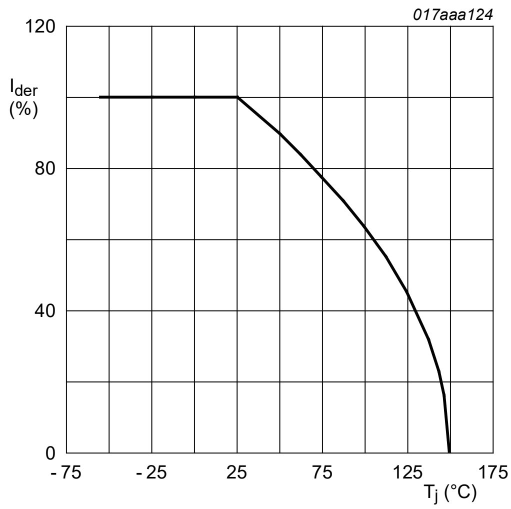
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	T_j = 25 °C		-	60	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = 10 V; T_{amb} = 25 °C; t ≤ 5 s	[1]	-	6.1	A
		V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	4.8	A
		V_{GS} = 10 V; T_{amb} = 100 °C	[1]	-	3	A
I_{DM}	peak drain 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 cm^2.
[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.



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

Fig. 2. Normalized total power dissipation as a function of junction temperature



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

Fig. 3. Normalized continuous drain current as a function of junction temperature

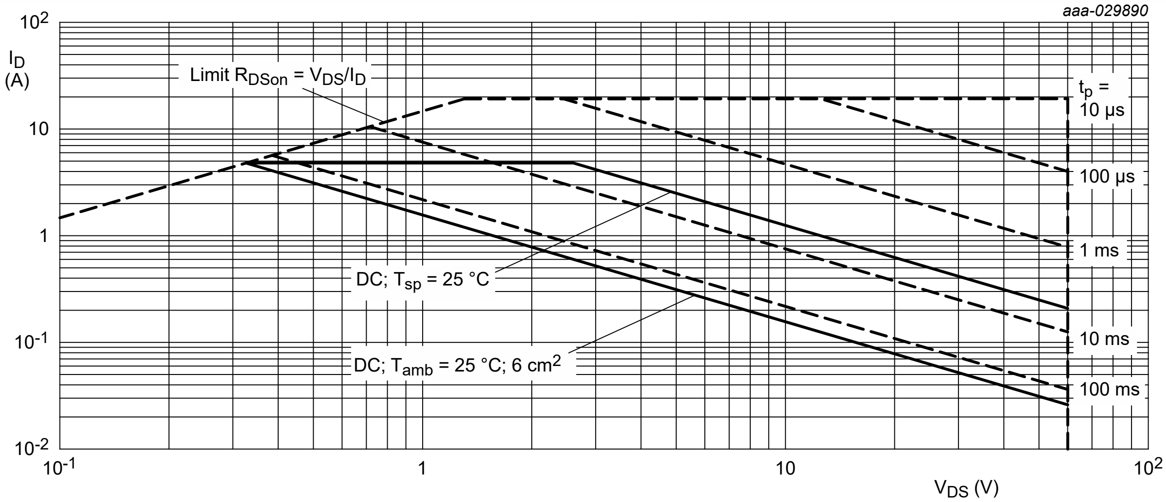


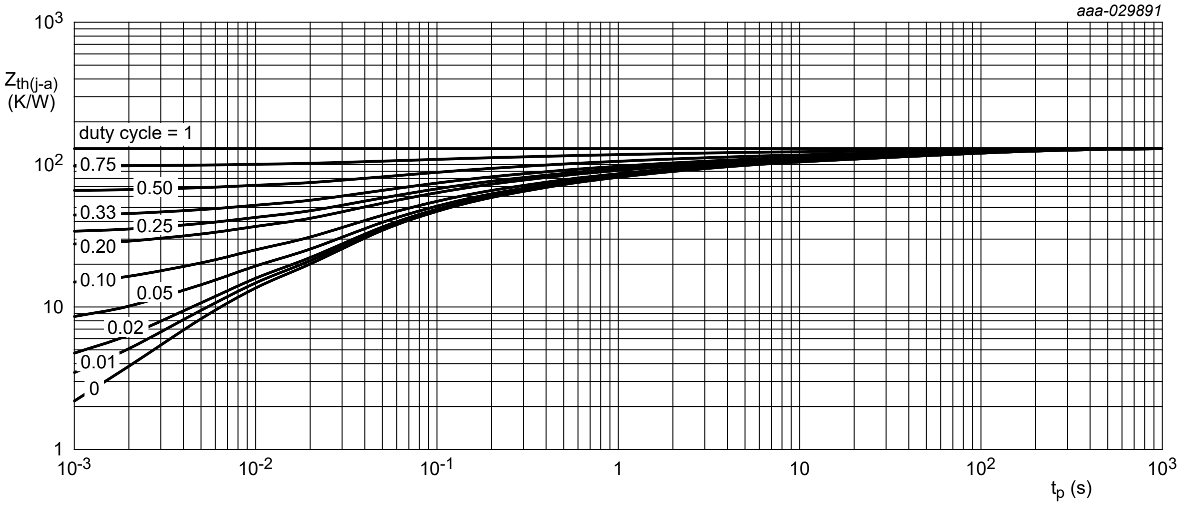
Fig. 4. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

9. Thermal characteristics

Table 6. Thermal characteristics

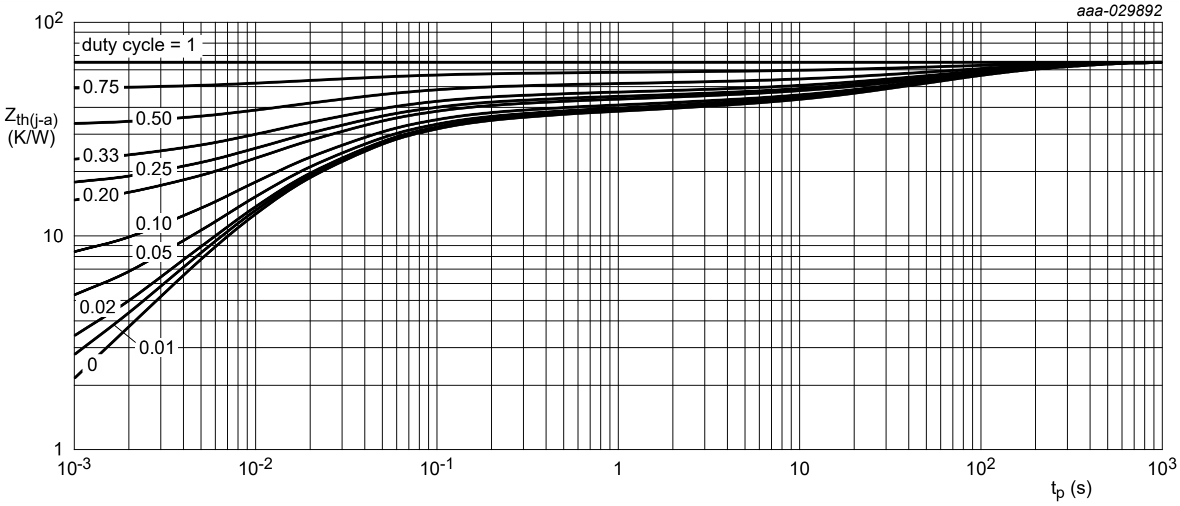
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	130	160	K/W
			[2]	-	50	60	K/W
			[3]	-	65	80	K/W
		t ≤ 5 s	[3]	-	42	50	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	5	10	K/W

[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 cm^2.
[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain 6 cm^2.



FR4 PCB, standard footprint

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



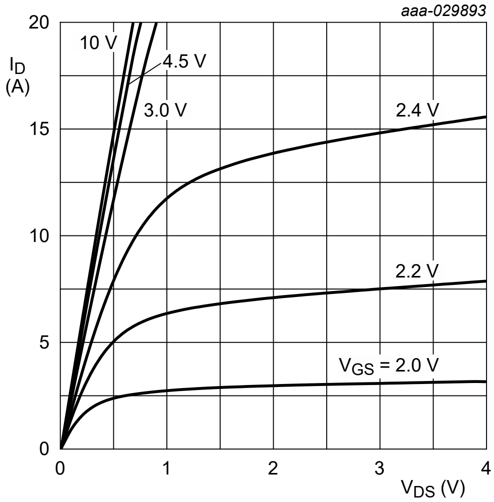
FR4 PCB, mounting pad for drain 6 cm^2

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

10. Characteristics

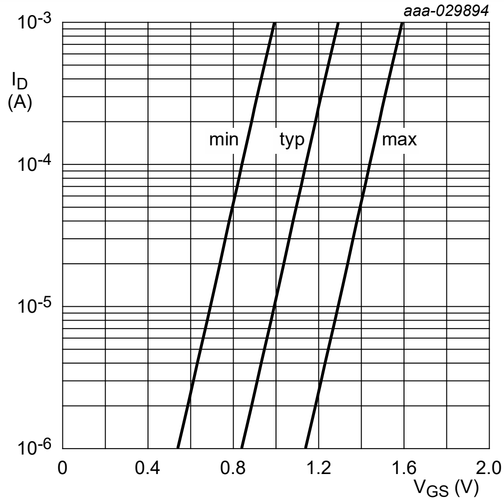
Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 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		0.9	1.2	1.5	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	-	1	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
		V_{GS} = 8 V; V_{DS} = 0 V; T_j = 25 °C		-	-	1	µA
		V_{GS} = -8 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-1	µA
		V_{GS} = 4.5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	200	nA
		V_{GS} = -4.5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-200	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 3 A; T_j = 25 °C		-	28	41	mΩ
		V_{GS} = 10 V; I_D = 3 A; T_j = 150 °C		-	46	68	mΩ
		V_{GS} = 4.5 V; I_D = 3 A; T_j = 25 °C		-	31	47	mΩ
g_{fs}	forward transconductance	V_{DS} = 5 V; I_D = 3 A; T_j = 25 °C		-	20	-	S
R_G	gate resistance	f = 1 MHz		-	5.7	-	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	V_{DS} = 30 V; I_D = 3 A; V_{GS} = 10 V; T_j = 25 °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 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °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 V; I_D = 3 A; V_{GS} = 10 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °C		-	2	-	ns
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 A; V_{GS} = 0 V; T_j = 25 °C		-	0.7	1.2	V



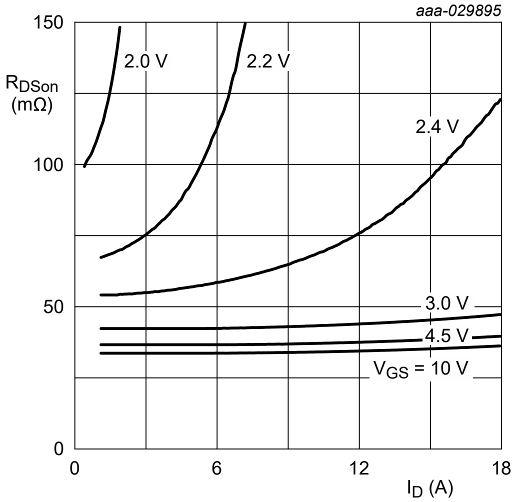
T_j = 25 °C

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



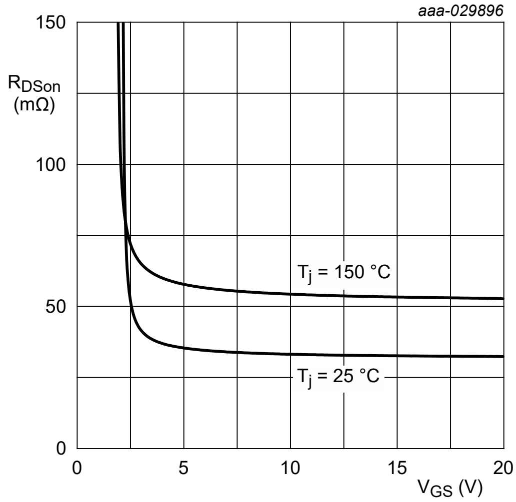
V_{DS} = 5 V; T_j = 25 °C

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



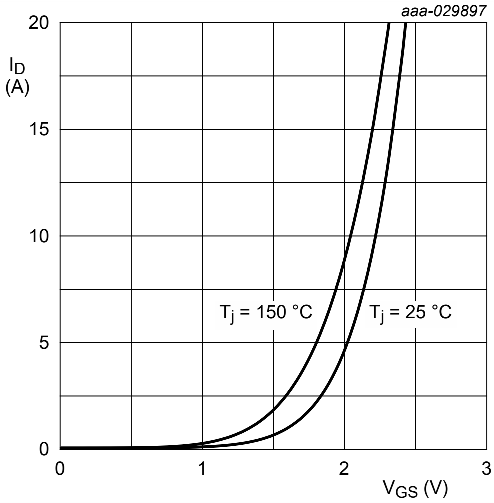
T_j = 25 °C

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



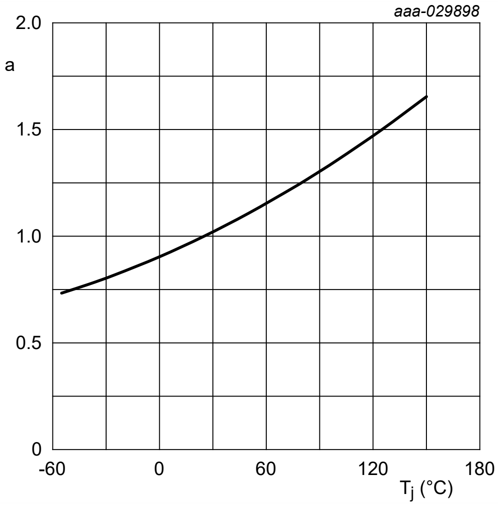
I_D = 6.1 A

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



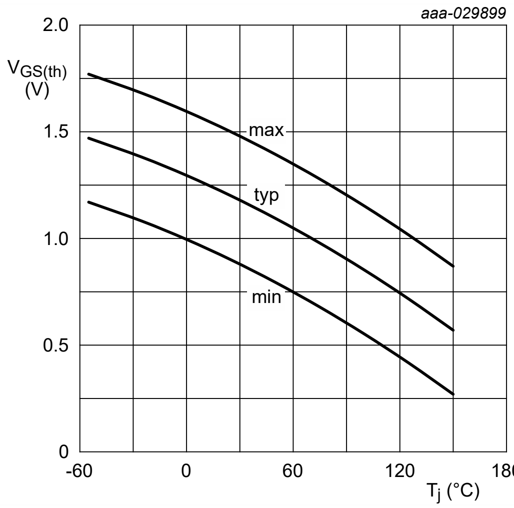
$V_{DS} > I_D \times R_{DSon}$

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



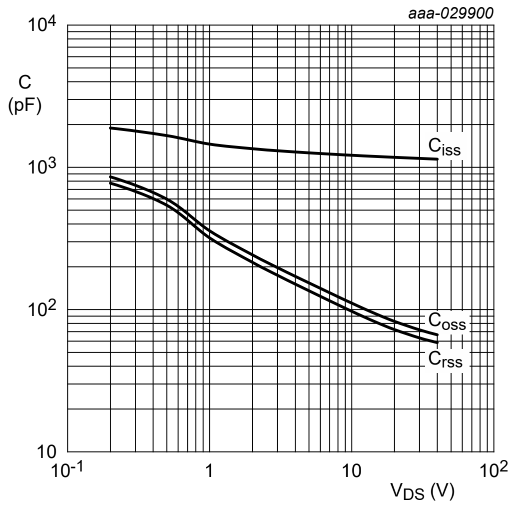
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



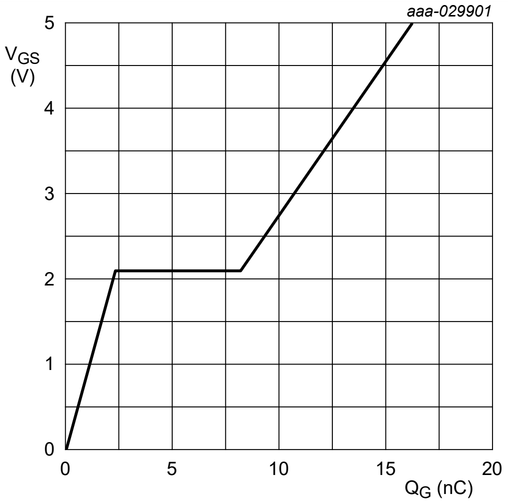
I_D = 250 µA; $V_{DS} = V_{GS}$

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



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

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



V_{DS} = 30 V; I_D = 3 A; T_{amb} = 25 ºC

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

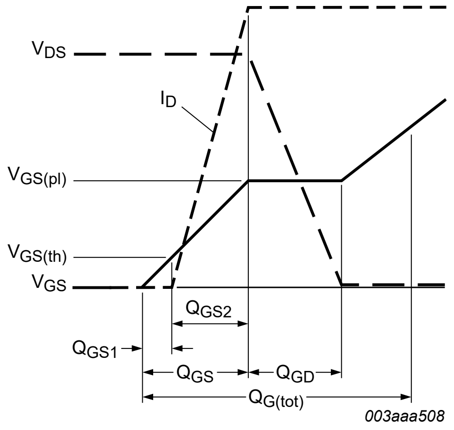
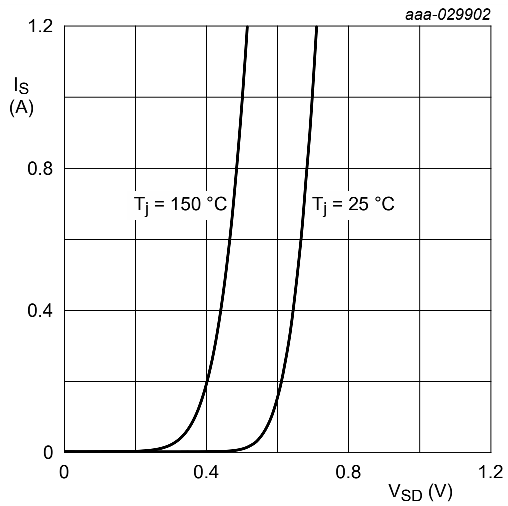


Fig. 16. Gate charge waveform definitions



V_{GS} = 0 V

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

11. Test information

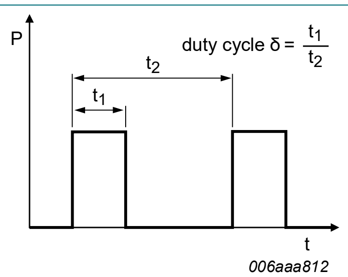
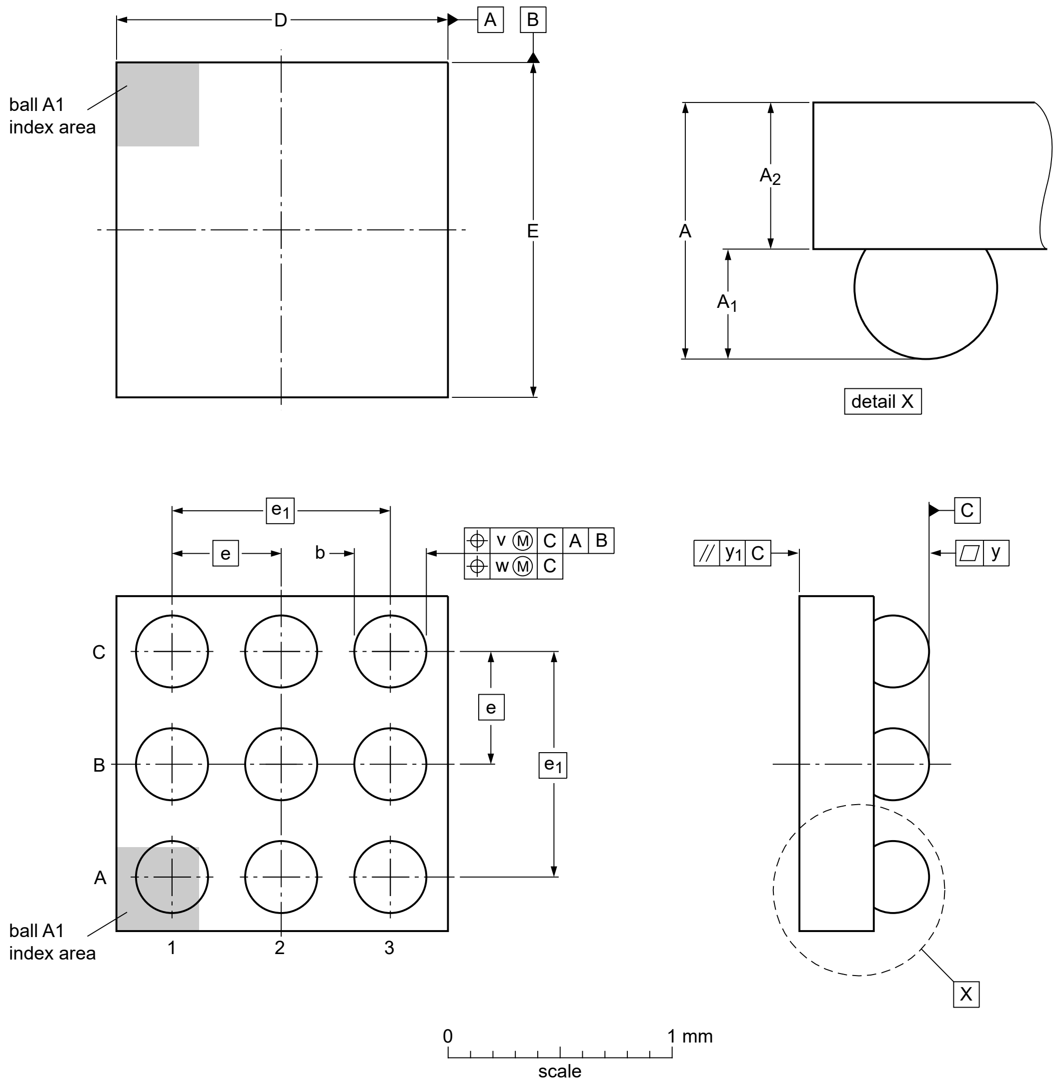


Fig. 18. Duty cycle definition

12. Package outline

WLCSP9: wafer level chip-size package; 9 bumps (3 x 3) **WLCSP9_3x3**



Dimensions (mm are the original dimensions)

Unit		A	A_1	A_2	b	D	E	e	e_1	v	w	y
mm	max	0.38	0.17	0.21	0.24	1.51	1.51					
	nom	0.35	0.15	0.20	0.22	1.48	1.48	0.50	1.00	0.15	0.05	0.05
	min	0.32	0.13	0.19	0.20	1.45	1.45					

Note

Device back is metal coated on Drain potential.

wlcsp9_3x3_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
WLCSP9_3x3						~~18-05-23~~ 18-06-06

Fig. 19. Package outline WLCSP9 (WLCSP9_3x3)

13. Soldering

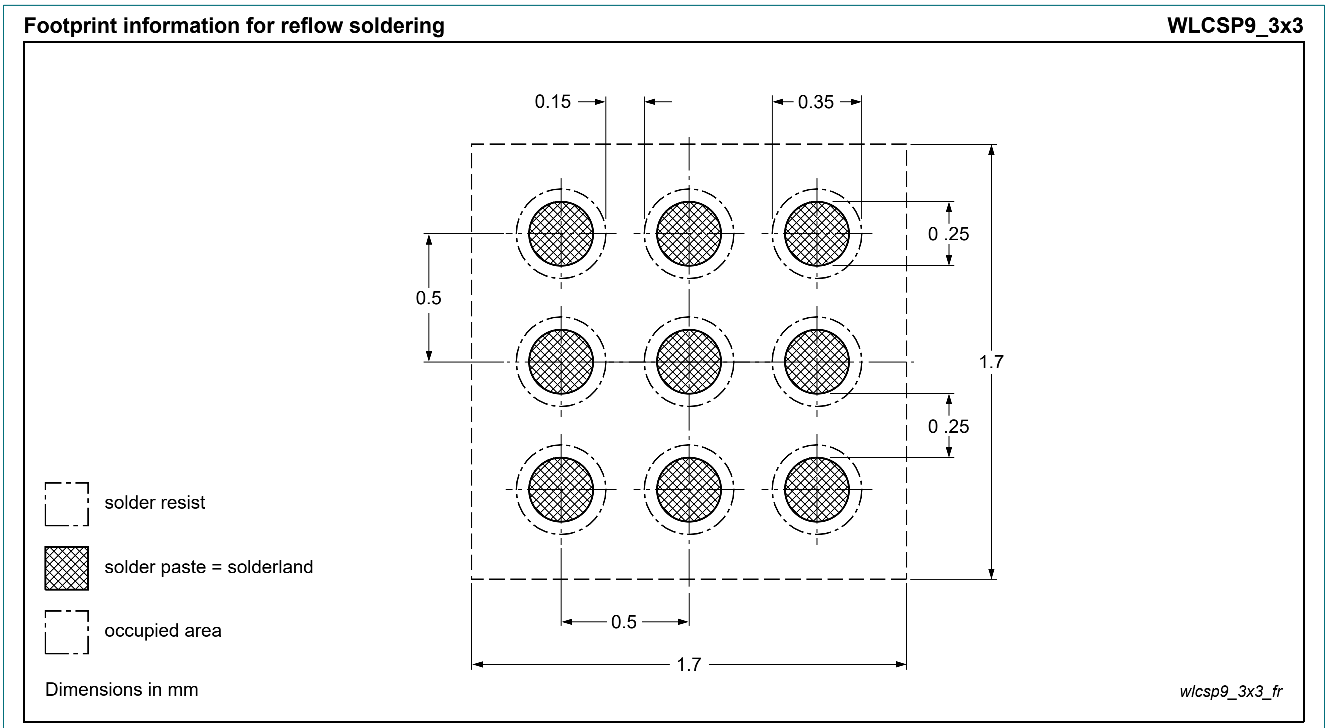


Fig. 20. Reflow soldering footprint for WLCSP9 (WLCSP9_3x3)

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.

[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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