

# PMCM650CUNE

20 V, Common Drain N-channel Trench MOSFET

Rev. 1.0 — 8 November 2017

Product data sheet

## 1 Product profile

### 1.1 General description

N-channel enhancement mode common-drain dual Field-Effect Transistor (FET) in a 6 bumps Wafer Level Chip-Size Package (WLCSP) using Trench MOSFET technology.

### 1.2 Features and benefits

- Common-drain type for bi-directional current flow
- Low threshold voltage
- Ultra small package: 0.98 × 1.48 × 0.35 mm
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection > 2 kV HBM

### 1.3 Applications

- Loadswitch
- Battery Protection
- Battery Management

### 1.4 Quick reference data

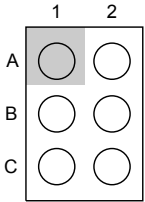
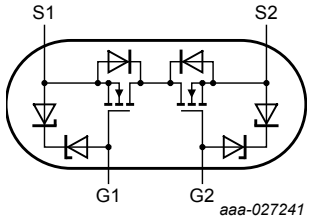
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{SS}$	source-source voltage	$T_j = 25\text{ °C}$	-	-	20	V
$V_{GS}$	gate-source voltage		-8	-	8	V
$I_S$	source current	$T_{amb} = 25\text{ °C}; V_{GS} = 4.5\text{ V}; t \leq 5\text{ s}$ [1]	-	-	5.3	A
<b>Static characteristics</b>						
$R_{SSon}$	source-source on-state resistance	$V_{GS} = 4.5\text{ V}; I_S = 3\text{ A}; T_j = 25\text{ °C}$	-	40	52	mΩ

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm<sup>2</sup>.

## 2 Pinning information

Table 2. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
A1	G1	gate 1	 <p>Transparent top view</p>	
A2	S1	source 1		
B1	S2	source 2		
B2	S1	source 1		
C1	S2	source 2		
C2	G2	gate 2		

## 3 Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMCM650CUNE	WLCSP6	wafer level chip-size package; 6 bumps (3 x 2)	WLCSP6_3-2

## 4 Marking

Table 4. Marking codes

Type number	Marking code
PMCM650CUNE	AH

## 5 Limiting values

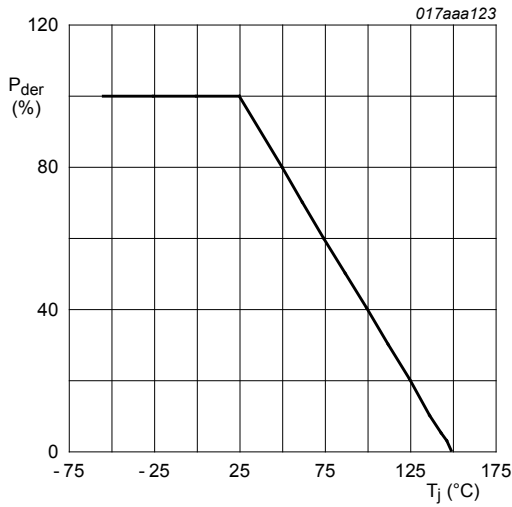
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{SS}$	source-source voltage	$T_j = 25\text{ °C}$		-	20	V
$V_{GS}$	gate-source voltage	$T_j = 25\text{ °C}$		-8	8	V
$I_S$	source current	$T_{amb} = 25\text{ °C}; V_{GS} = 4.5\text{ V}; t \leq 5\text{ s}$	[1]	-	5.3	A
		$T_{amb} = 25\text{ °C}; V_{GS} = 4.5\text{ V}$	[1]	-	4.1	A
		$T_{amb} = 100\text{ °C}; V_{GS} = 4.5\text{ V}$	[1]	-	2.6	A
$I_{SM}$	peak source current	$T_{amb} = 25\text{ °C}$ ; single pulse; $t_p \leq 10\text{ }\mu\text{s}$		-	16	A
$P_{tot}$	total power dissipation	$T_{amb} = 25\text{ °C}$	[2]	-	556	mW
		$T_{amb} = 25\text{ °C}$	[1]	-	1300	mW
		$T_{sp} = 25\text{ °C}$		-	12500	mW
$T_j$	junction temperature			-55	150	°C
$T_{amb}$	ambient temperature			-55	150	°C
$T_{stg}$	storage temperature			-65	150	°C
<b>Source-Forward diode</b>						
$I_{FS}$	source-forward current	$T_{amb} = 25\text{ °C}$	[1]	-	1.2	A

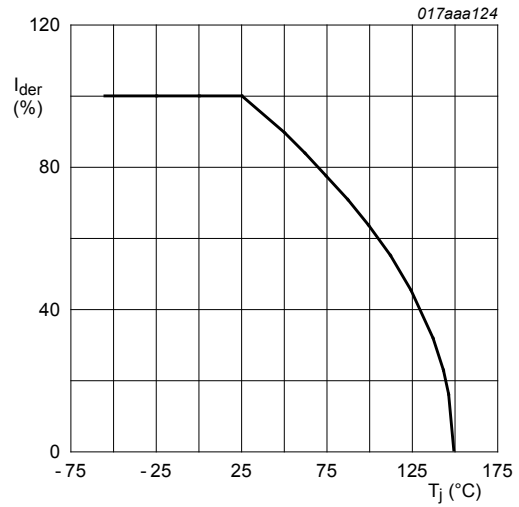
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain  $6\text{ cm}^2$ .

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



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

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



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

Figure 2. Normalized continuous source-source current as a function of junction temperature

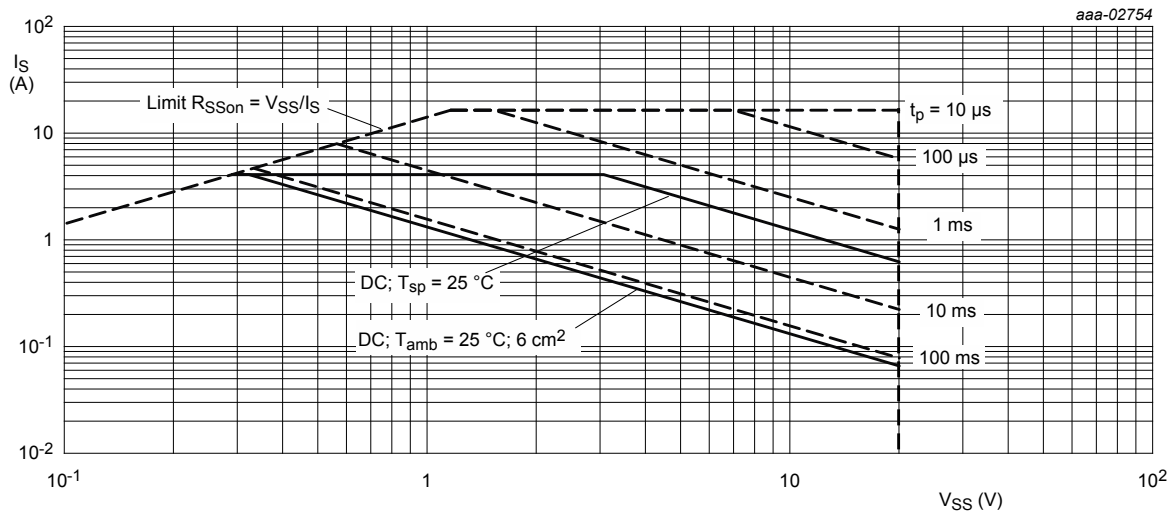


Figure 3. Safe operating area; junction to ambient; continuous and peak source currents as a function of source-source voltage

## 6 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]	-	180	225	K/W
			[2]	-	65	85	K/W
			[3]	-	75	95	K/W
		in free air; $t \leq 5$ s	[3]	-	45	55	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	5	10	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, 4 layer, 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain 6 cm<sup>2</sup>.

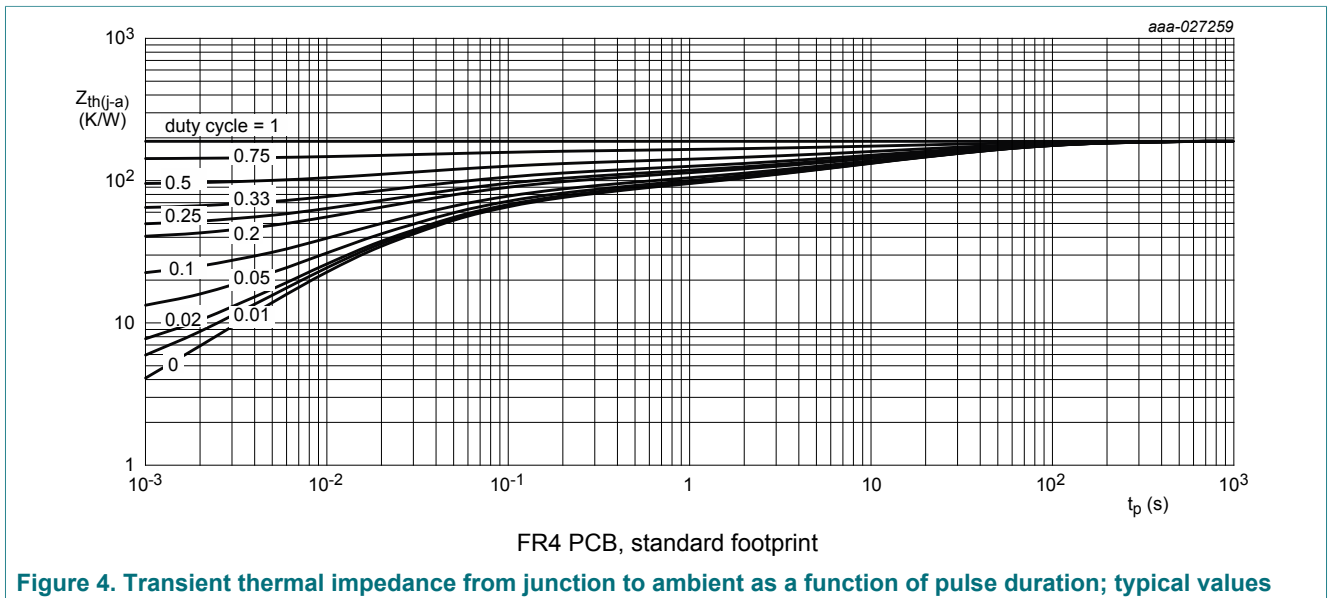


Figure 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

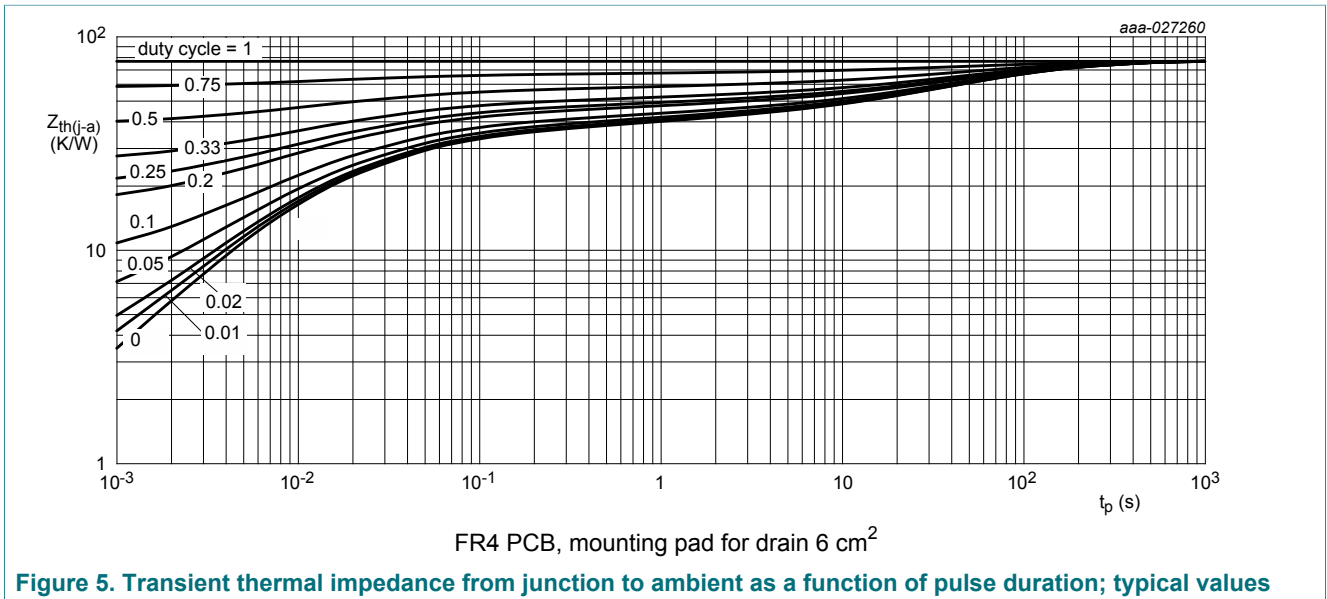
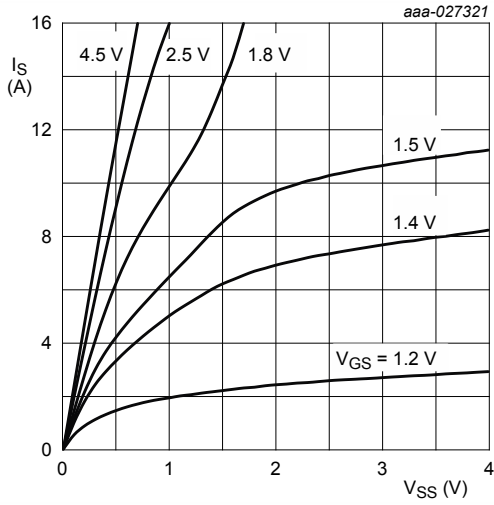


Figure 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 7 Characteristics

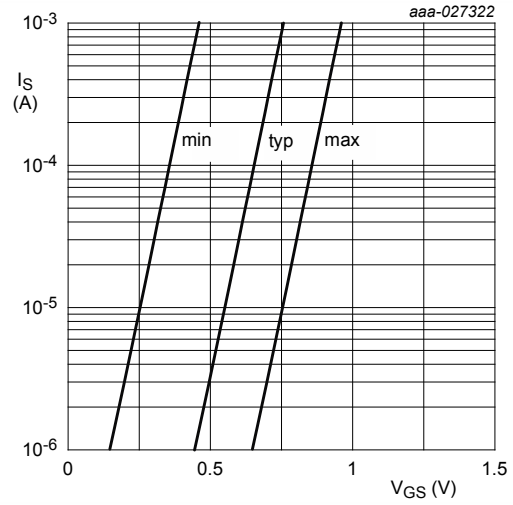
**Table 7. Characteristics**
 $T_j = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristic</b>						
$V_{(BR)SS}$	source-source breakdown voltage	$I_S = 250\ \mu\text{A}$ ; $V_{GS} = 0\ \text{V}$ ;	20	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250\ \mu\text{A}$ ; $V_{SS} = V_{GS}$	0.4	0.7	0.9	V
$I_{SSS}$	source leakage current	$V_{GS} = 0\ \text{V}$ ; $V_{SS} = 20\ \text{V}$	-	-	1	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 8\ \text{V}$ ; $V_{SS} = 0\ \text{V}$	-	-	10	$\mu\text{A}$
		$V_{GS} = -8\ \text{V}$ ; $V_{SS} = 0\ \text{V}$	-	-	-10	$\mu\text{A}$
		$V_{GS} = 4.5\ \text{V}$ ; $V_{SS} = 0\ \text{V}$	-	-	1	$\mu\text{A}$
		$V_{GS} = -4.5\ \text{V}$ ; $V_{SS} = 0\ \text{V}$	-	-	-1	$\mu\text{A}$
		$V_{GS} = 2.5\ \text{V}$ ; $V_{SS} = 0\ \text{V}$	-	-	200	nA
		$V_{GS} = -2.5\ \text{V}$ ; $V_{SS} = 0\ \text{V}$	-	-	-200	nA
$R_{SSon}$	source-source on-state resistance	$V_{GS} = 4.5\ \text{V}$ ; $I_S = 3\ \text{A}$ ; $T_j = 25\text{ °C}$	-	40	52	m $\Omega$
		$V_{GS} = 4.5\ \text{V}$ ; $I_S = 3\ \text{A}$ ; $T_j = 150\text{ °C}$	-	55	71	m $\Omega$
		$V_{GS} = 2.5\ \text{V}$ ; $I_S = 2\ \text{A}$ ; $T_j = 25\text{ °C}$	-	50	62	m $\Omega$
		$V_{GS} = 1.8\ \text{V}$ ; $I_S = 1\ \text{A}$ ; $T_j = 25\text{ °C}$	-	63	95	m $\Omega$
$g_{fs}$	forward transconductance	$V_{GS} = 4.5\ \text{V}$ ; $I_S = 3\ \text{A}$	-	22	-	S
$R_G$	gate resistance	$f = 1\ \text{MHz}$	-	6.6	-	$\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{SS} = 10\ \text{V}$ ; $I_S = 3\ \text{A}$ ; $V_{GS} = 4.5\ \text{V}$	-	9	13	nC
$Q_{GS}$	gate-source charge		-	0.7	-	nC
$Q_{GD}$	gate-drain charge		-	2.9	-	nC
$C_{iss}$	input capacitance	$V_{SS} = 10\ \text{V}$ ; $f = 1\ \text{MHz}$ ; $V_{GS} = 0\ \text{V}$	-	480	-	pF
$C_{oss}$	output capacitance		-	96	-	pF
$C_{rSS}$	reverse transfer capacitance		-	96	-	pF
$t_{d(on)}$	turn-on delay time		$V_{SS} = 10\ \text{V}$ ; $I_S = 3\ \text{A}$ ; $V_{GS} = 4.5\ \text{V}$ ; $R_{G(ext)} = 6\ \Omega$	-	6	-
$t_r$	rise time	-		20	-	ns
$t_{d(off)}$	turn-off delay time	-		39	-	ns
$t_f$	fall time	-		15	-	ns
<b>Source-Forward diode</b>						
$V_{FS}$	source-forward voltage	$V_{G1S1} = 0\ \text{V}$ ; $V_{G2S2} = 4.5\ \text{V}$ ; $I_S = 1.2\ \text{A}$	-	0.7	1.2	V



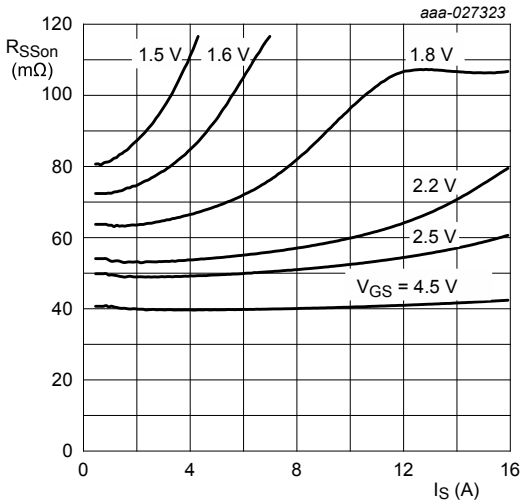
$T_j = 25\text{ }^\circ\text{C}$

Figure 6. Output characteristics: source current as a function of source-source voltage; typical values



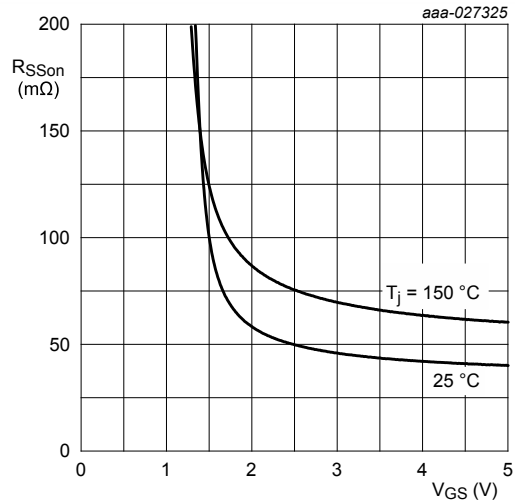
$V_{SS} = 5\text{ V}; T_j = 25\text{ }^\circ\text{C}$

Figure 7. Sub-threshold source current as a function of gate-source voltage



$T_j = 25\text{ }^\circ\text{C}$

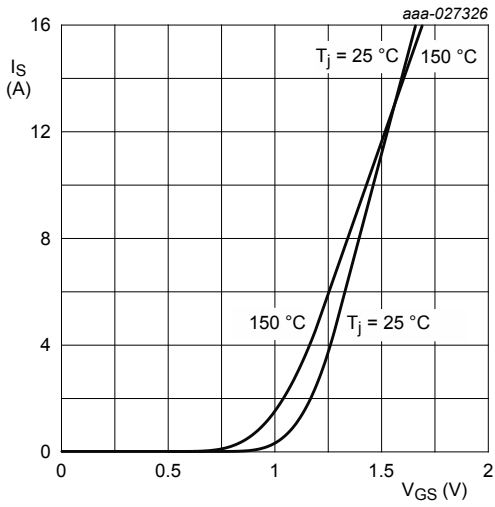
Figure 8. Source-source on-state resistance as a function of source current; typical values



$I_S = 3\text{ A}$

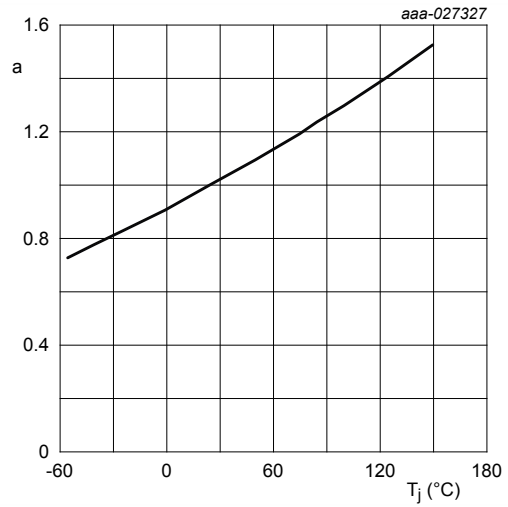
Figure 9. Source-source on-state resistance as a function of gate-source voltage; typical values





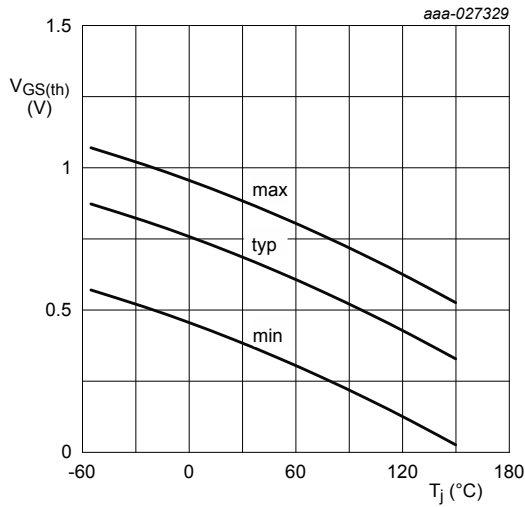
$$V_{SS} > I_S \times R_{SSon}$$

Figure 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values



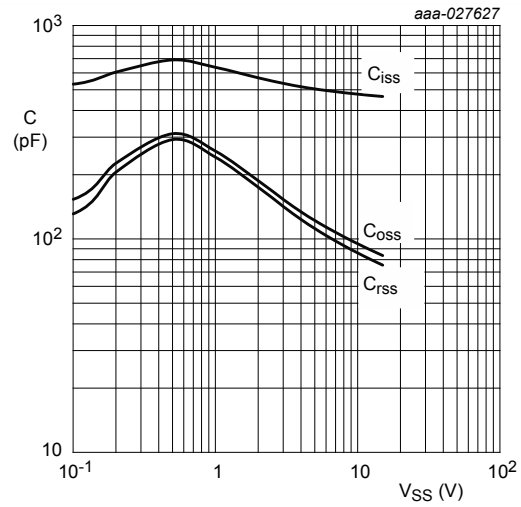
$$a = \frac{R_{SSon}}{R_{SSon(25\text{ °C})}} \times 100\%$$

Figure 11. Normalized source-source on-state resistance as a function of junction temperature; typical values



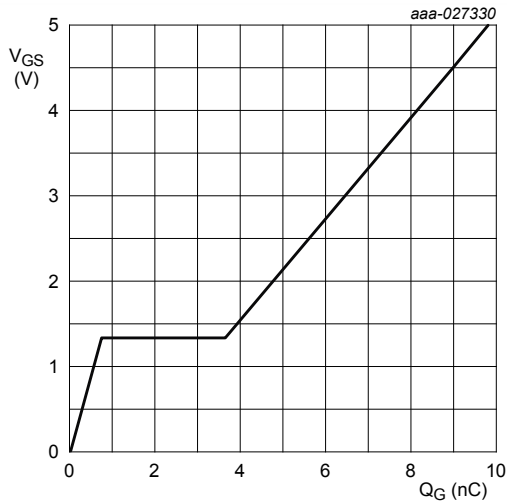
$$I_S = 250 \mu\text{A}; V_{SS} = V_{GS}$$

Figure 12. Gate-source threshold voltage as a function of junction temperature



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

Figure 13. Input, output and reverse transfer capacitances as a function of source-source voltage; typical values



$V_{SS} = 10\text{ V}$ ;  $I_S = 3\text{ A}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$

Figure 14. Gate-source voltage as a function of gate charge; typical values

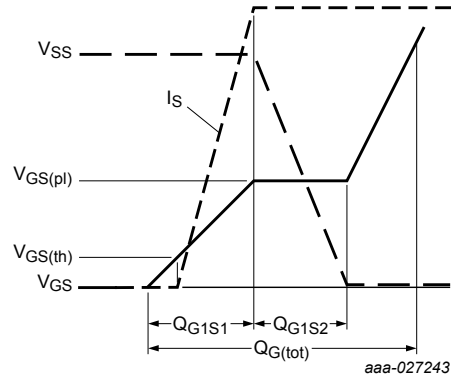
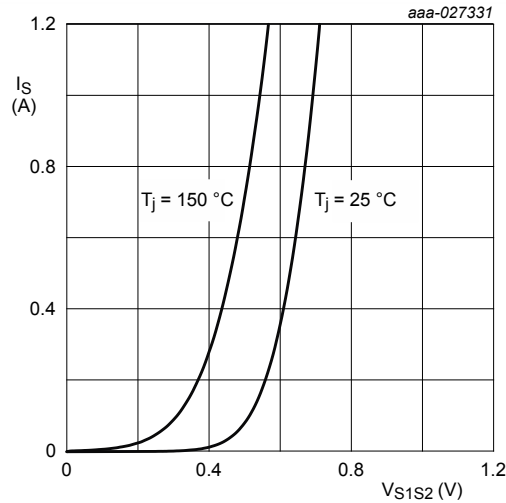


Figure 15. Common Drain MOSFET gate charge definitions



$V_{G1S1} = 0\text{ V}$ ;  $V_{G2S2} = 4.5\text{ V}$

Figure 16. Source current as a function of source-source voltage; typical values

## 8 Test information

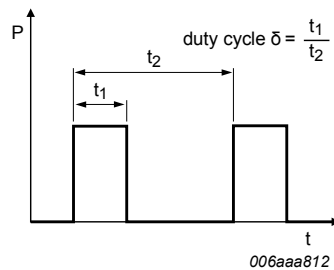
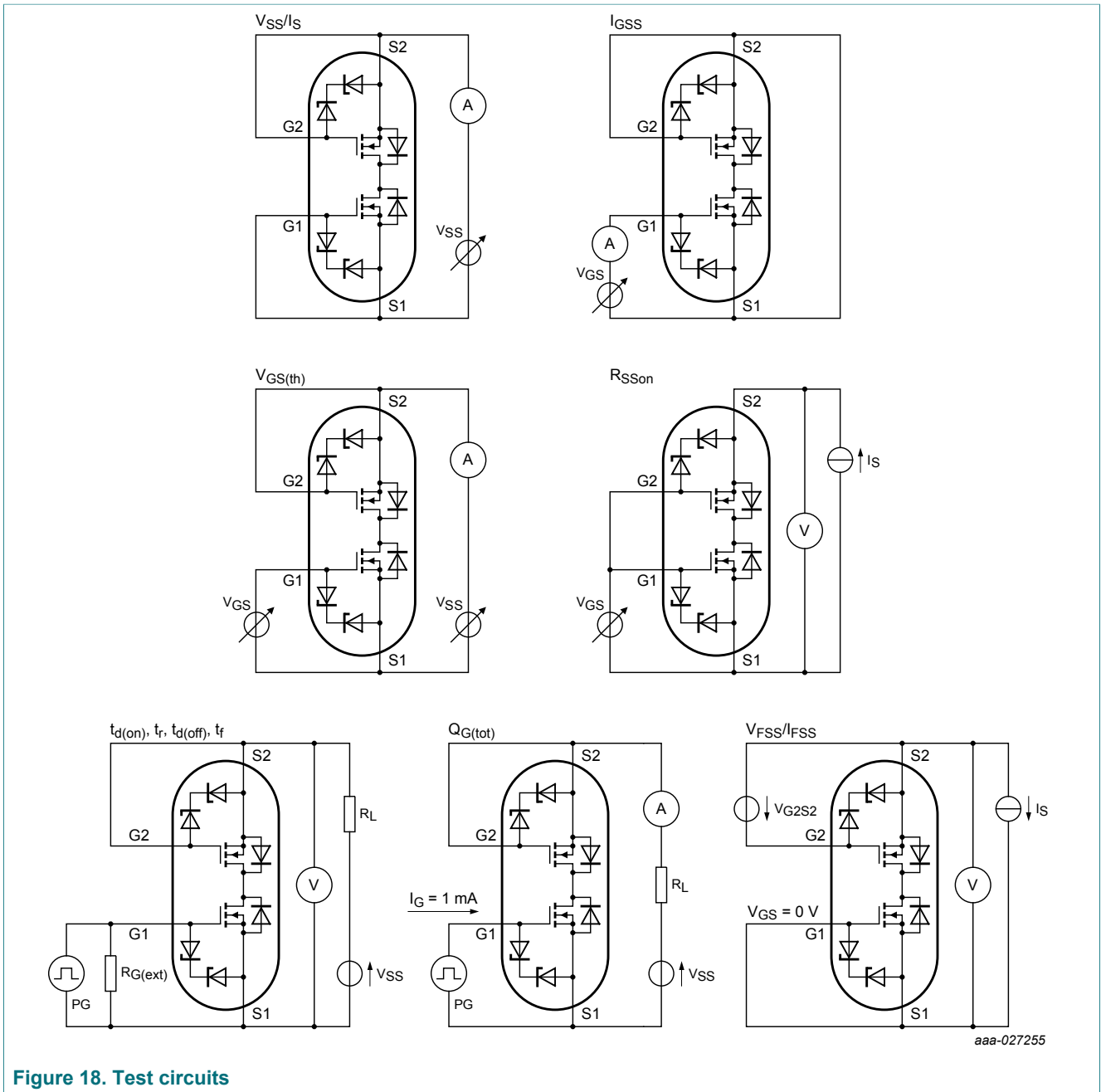


Figure 17. Duty cycle definition



aaa-027255

9 Package outline

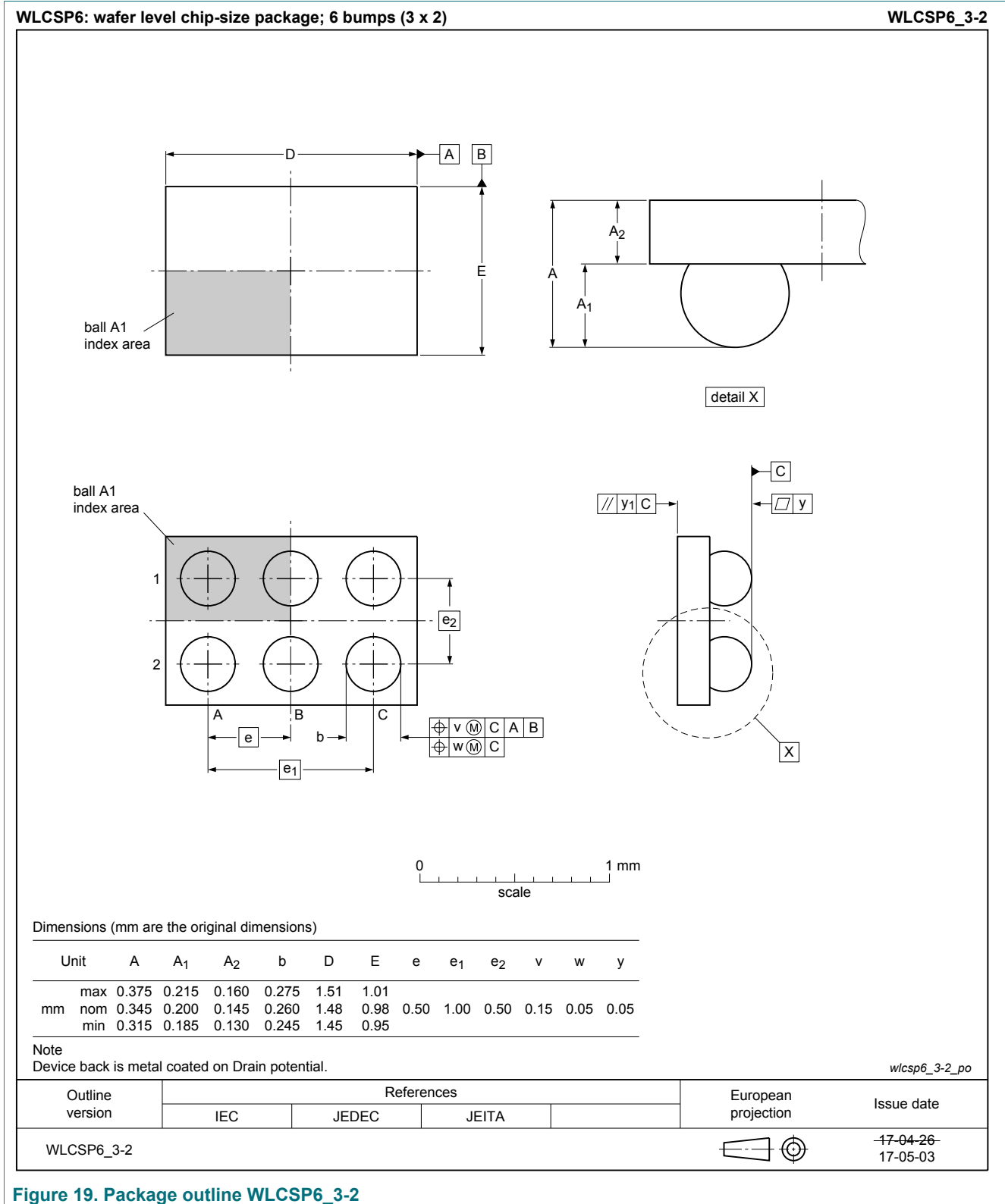
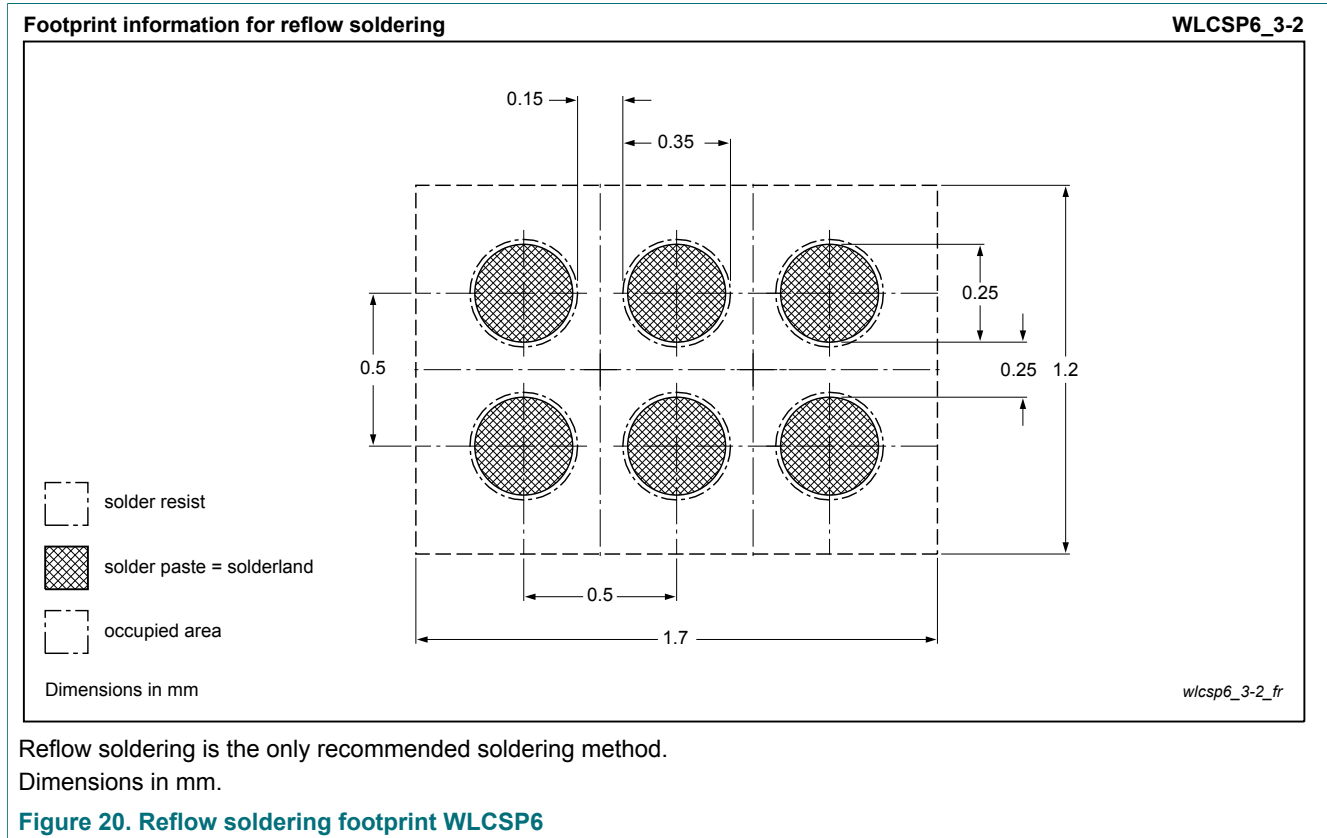


Figure 19. Package outline WLCSP6\_3-2

## 10 Soldering



## 11 Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PMCM650CUNE v.1	20171108	Product data sheet	-	-

## 12 Legal information

### 12.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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