

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: $0.98 \times 1.48 \times 0.35$ mm
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection > 2 kV HBM

1.3 Applications

- Loadswitch
- Battery Protection
- Battery Management

1.4 Quick reference data

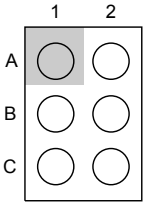
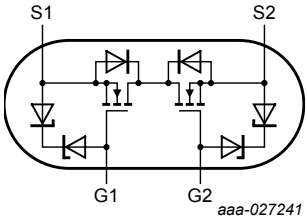
Table 1. Quick reference data

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
Static characteristics						
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^2 .

2 Pinning information

Table 2. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
A1	G1	gate 1	 Transparent top view	
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

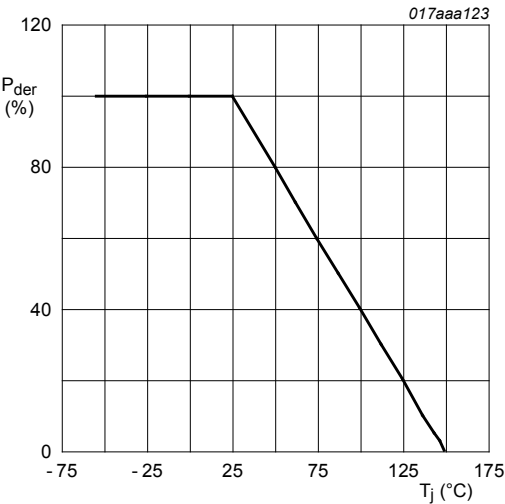
Table 5. Limiting values

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

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

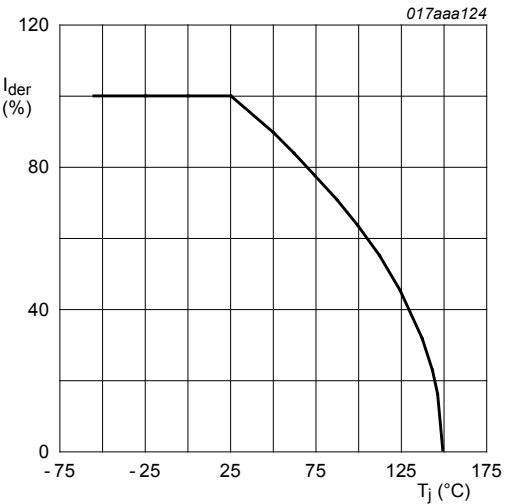
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm^2 .

[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

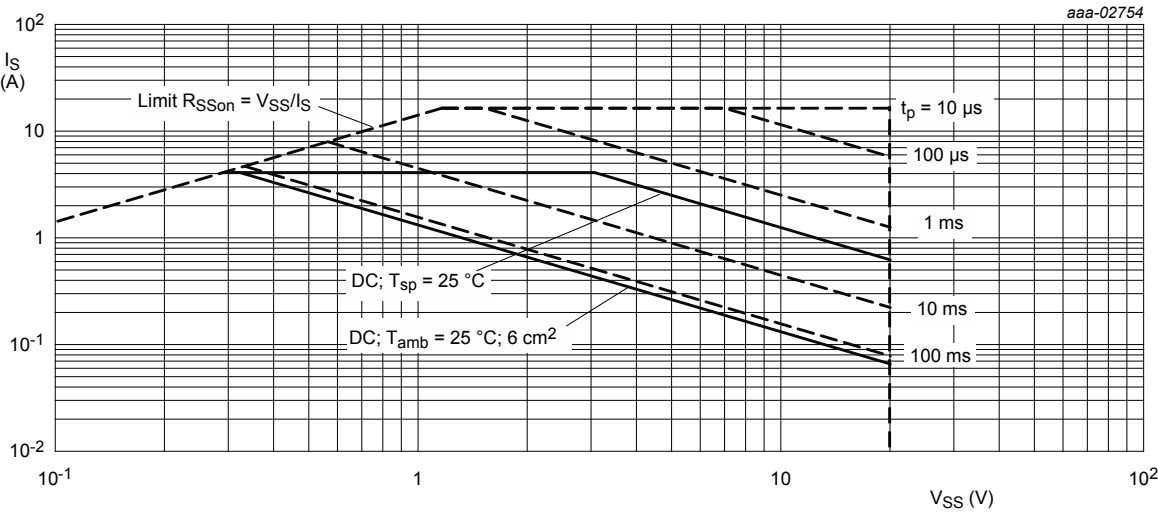


Figure 3. Safe operating area; junction to ambient; continuous and peak source currents as a function of source-source voltage

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

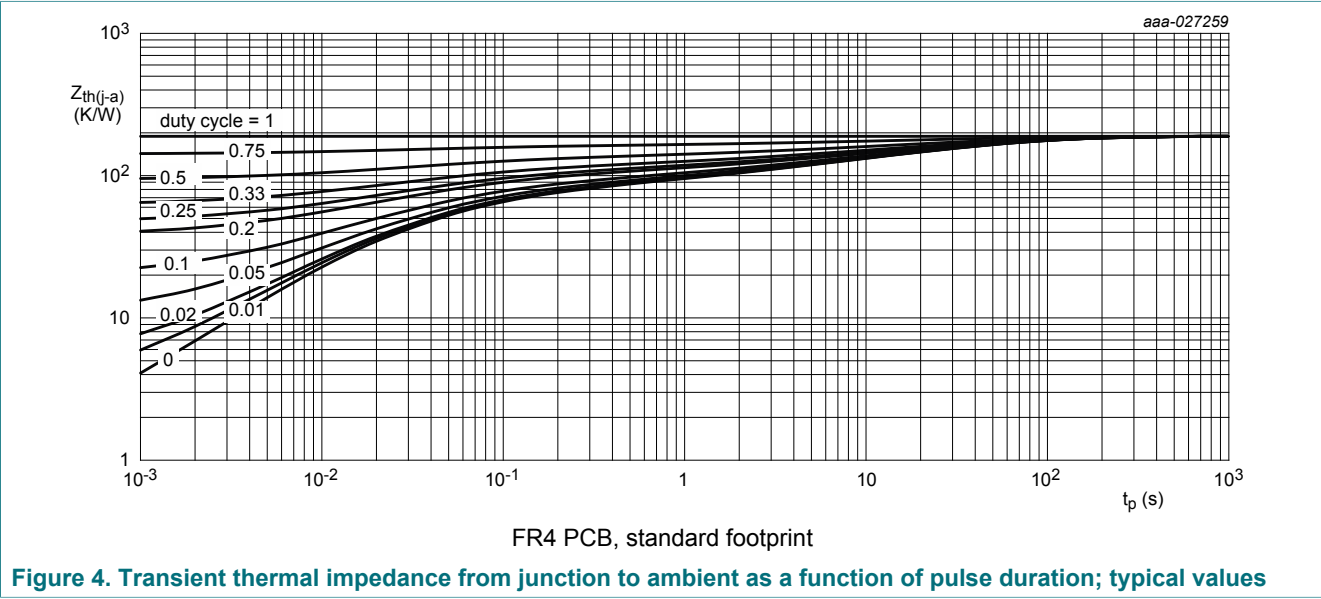
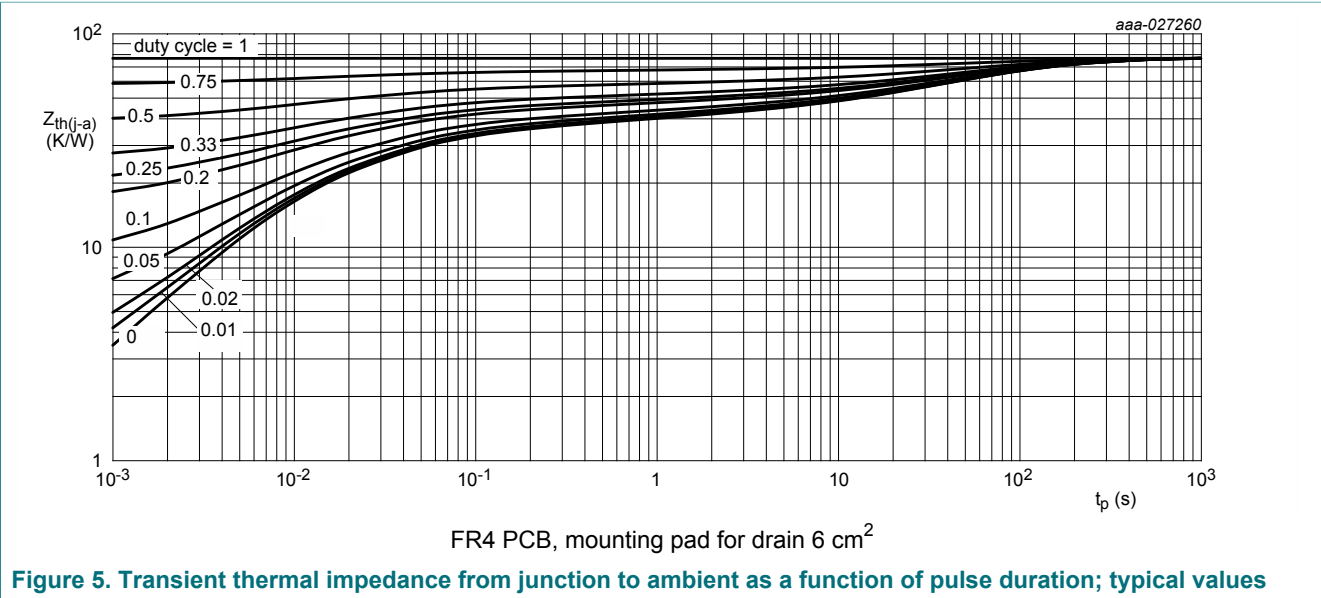


Figure 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

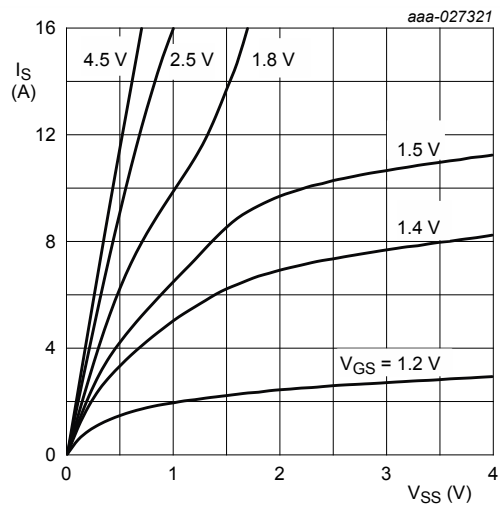


7 Characteristics

Table 7. Characteristics

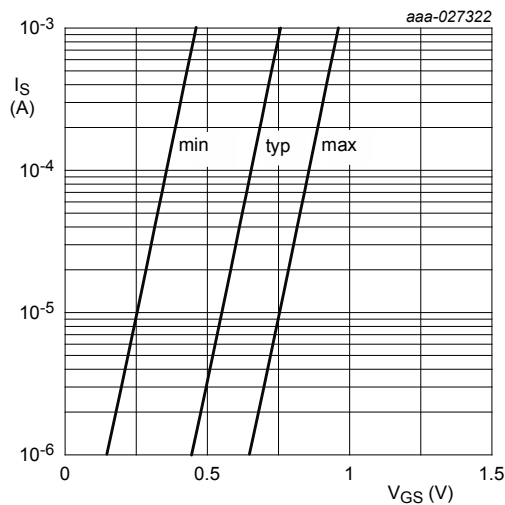
$T_j = 25\text{ °C}$ unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristic							
V _{(BR)SS}	source-source breakdown voltage	I _S = 250 μA; V _{GS} = 0 V;		20	-	-	V
V _{GSth}	gate-source threshold voltage	I _D = 250 μA; V _{SS} = V _{GS}		0.4	0.7	0.9	V
I _{SSS}	source leakage current	V _{GS} = 0 V; V _{SS} = 20 V		-	-	1	μA
I _{GSS}	gate leakage current	V _{GS} = 8 V; V _{SS} = 0 V		-	-	10	μA
		V _{GS} = -8 V; V _{SS} = 0 V		-	-	-10	μA
		V _{GS} = 4.5 V; V _{SS} = 0 V		-	-	1	μA
		V _{GS} = -4.5 V; V _{SS} = 0 V		-	-	-1	μA
		V _{GS} = 2.5 V; V _{SS} = 0 V		-	-	200	nA
		V _{GS} = -2.5 V; V _{SS} = 0 V		-	-	-200	nA
R _{SSon}	source-source on-state resistance	V _{GS} = 4.5 V; I _S = 3 A; T _j = 25 °C		-	40	52	mΩ
		V _{GS} = 4.5 V; I _S = 3 A; T _j = 150 °C		-	55	71	mΩ
		V _{GS} = 2.5 V; I _S = 2 A; T _j = 25 °C		-	50	62	mΩ
		V _{GS} = 1.8 V; I _S = 1 A; T _j = 25 °C		-	63	95	mΩ
g _{fs}	forward transconductance	V _{GS} = 4.5 V; I _S = 3 A		-	22	-	S
R _G	gate resistance	f = 1 MHz		-	6.6	-	Ω
Dynamic characteristics							
Q _{G(tot)}	total gate charge	V _{SS} = 10 V; I _S = 3 A; V _{GS} = 4.5 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 V; f = 1 MHz; V _{GS} = 0 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 V; I _S = 3 A; V _{GS} = 4.5 V; R _{G(ext)} = 6 Ω		-	6	-
t _r	rise time			-	20	-	ns
t _{d(off)}	turn-off delay time			-	39	-	ns
t _f	fall time			-	15	-	ns
Source-Foward diode							
V _{FS}	source-forward voltage	V _{G1S1} = 0 V ; V _{G2S2} = 4.5 V; I _S = 1.2 A		-	0.7	1.2	V



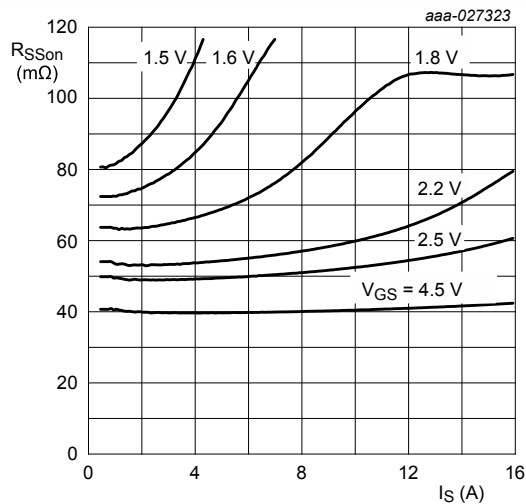
$T_j = 25\text{ }^{\circ}\text{C}$

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



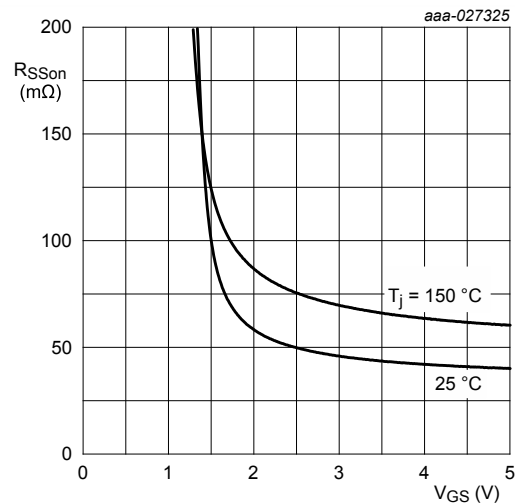
$V_{SS} = 5\text{ V}; T_j = 25\text{ }^{\circ}\text{C}$

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



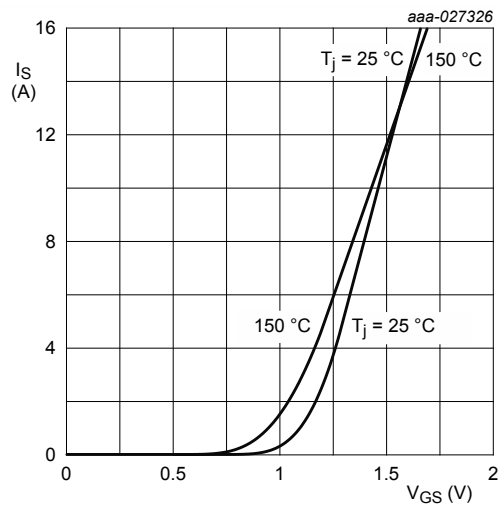
$T_j = 25\text{ }^{\circ}\text{C}$

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



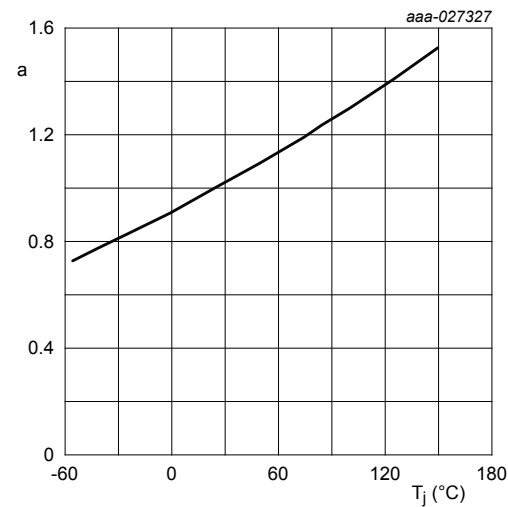
$I_S = 3\text{ A}$

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



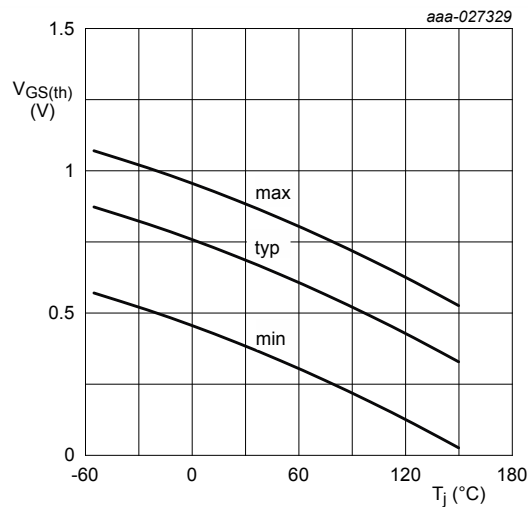
$V_{SS} > I_S \times R_{SSon}$

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



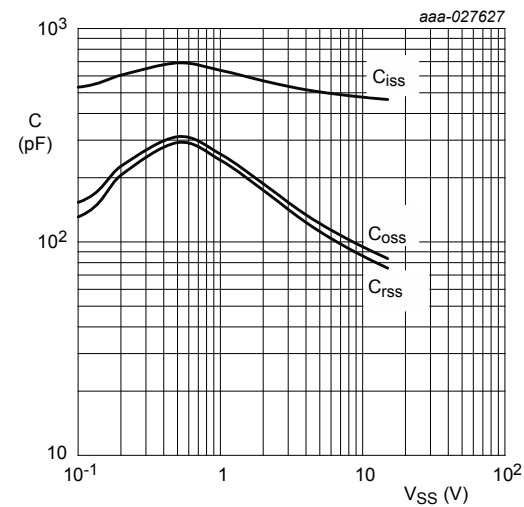
$$a = \frac{R_{SSon}}{R_{SSon}(25\text{ °C})} \times 100\%$$

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



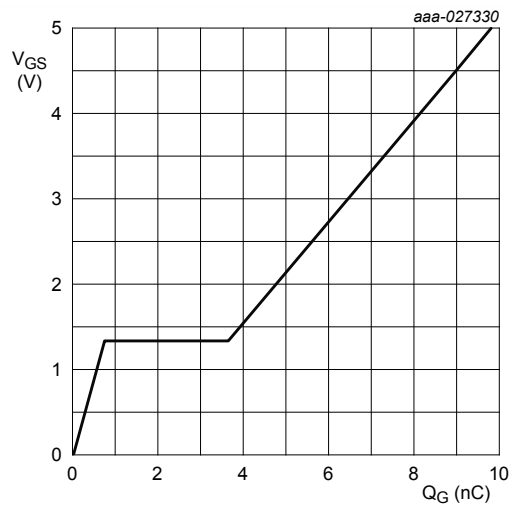
$I_S = 250\text{ }\mu\text{A}; V_{SS} = V_{GS}$

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

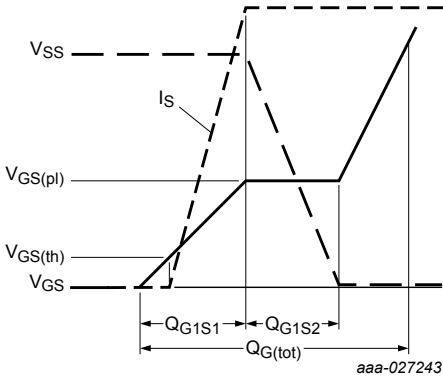
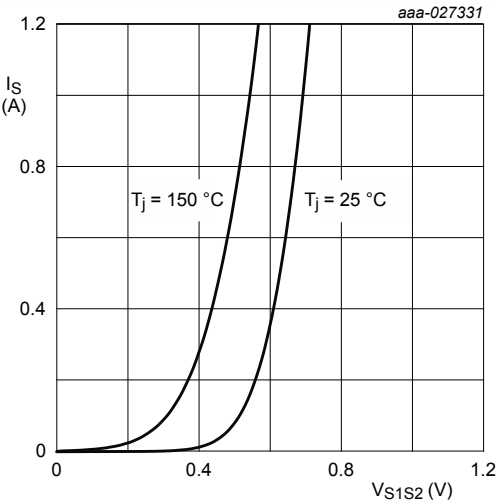


Figure 15. Common Drain MOSFET gate charge definitions



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

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

8 Test information

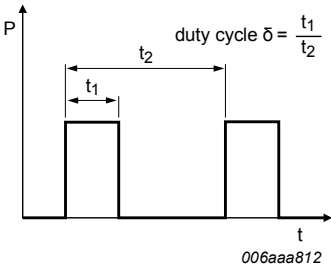


Figure 17. Duty cycle definition

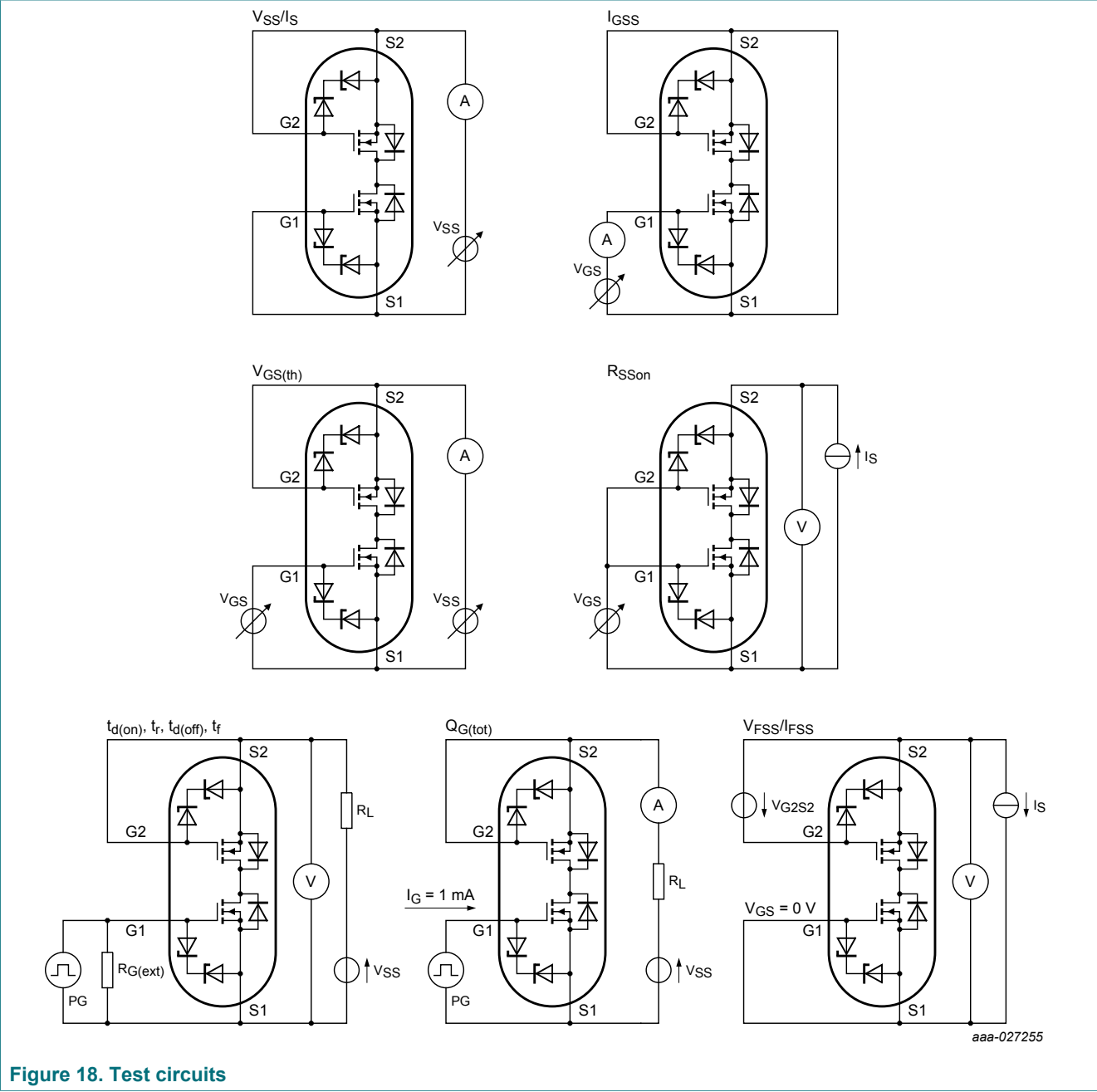
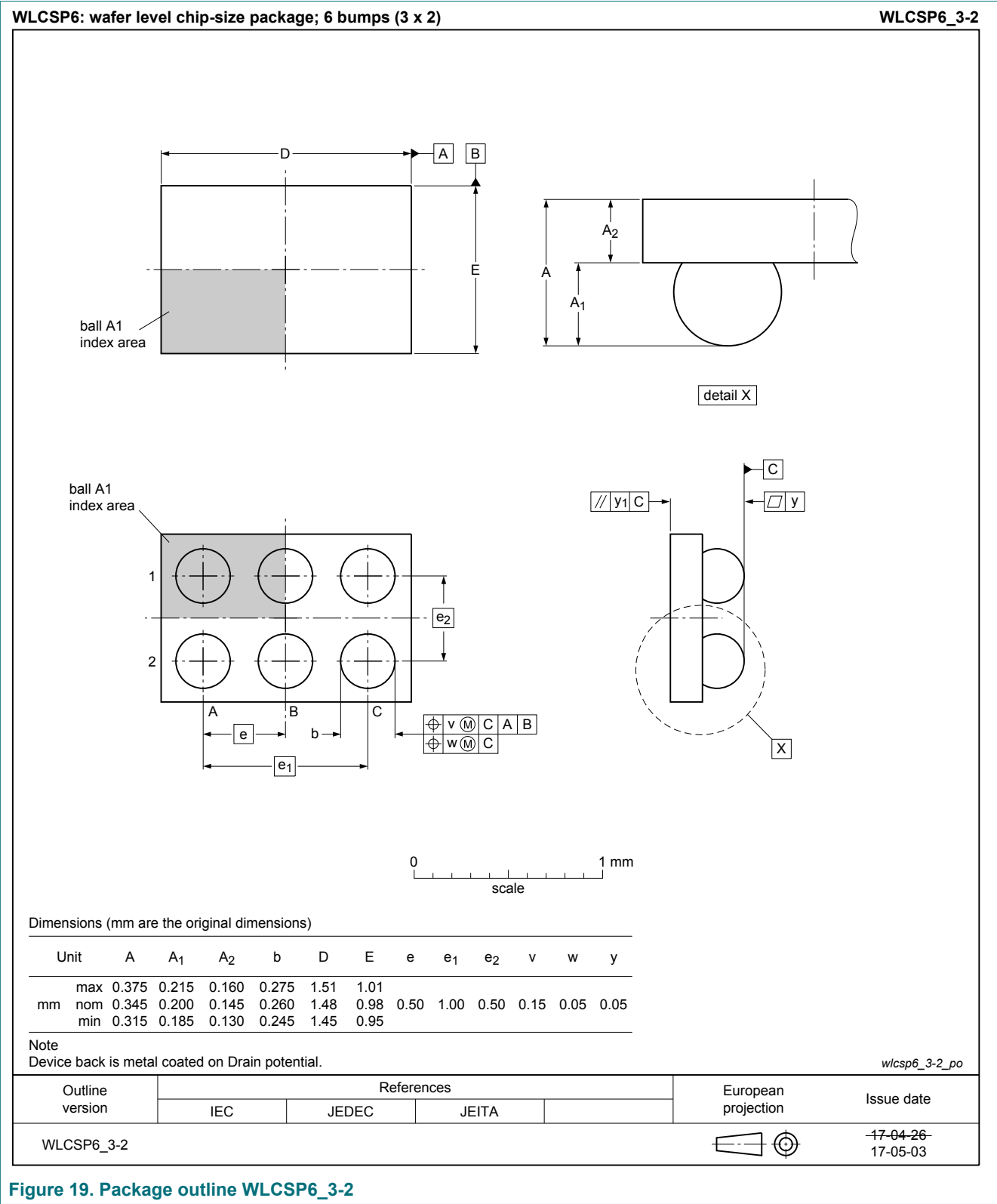
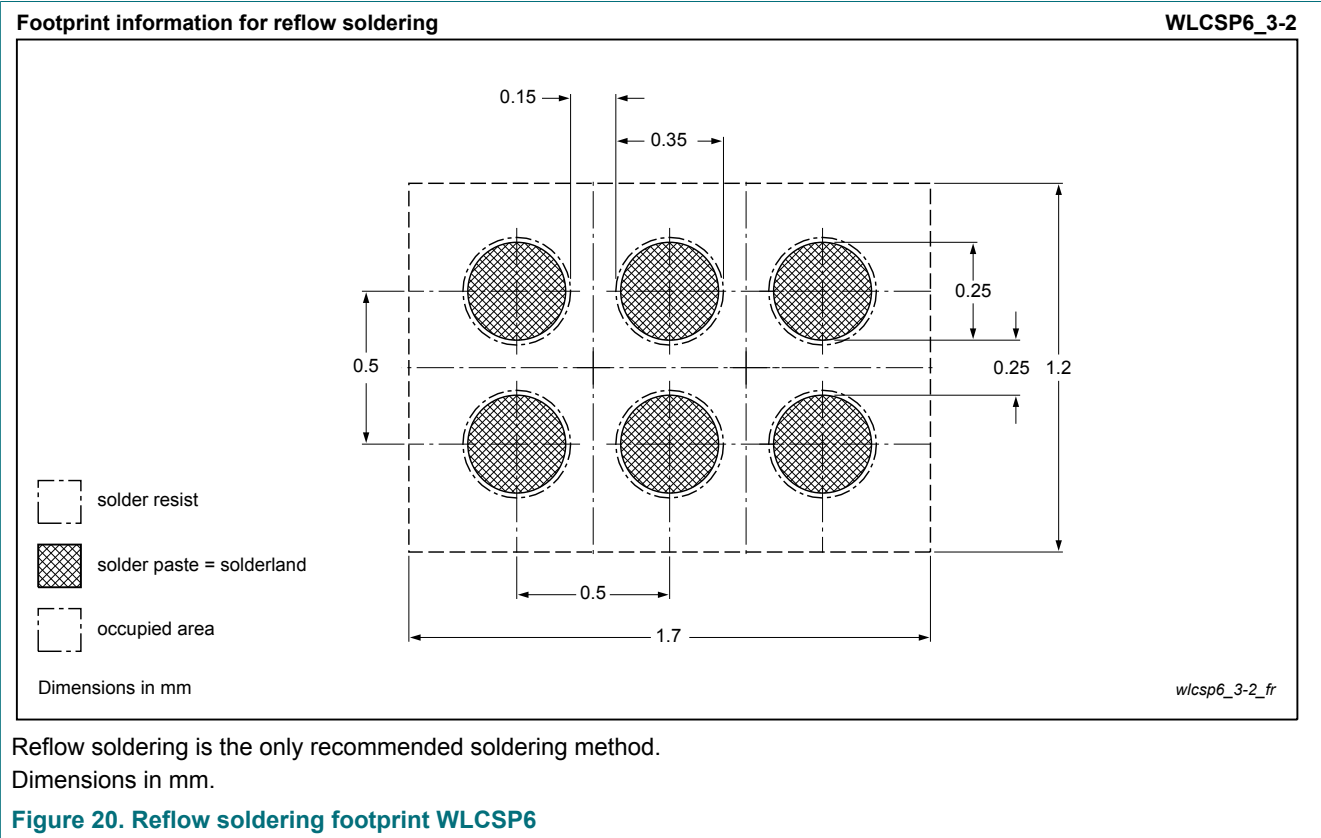


Figure 18. Test circuits

9 Package outline



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 ^{[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".

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