



BUK4D38-20P

20 V, P-channel Trench MOSFET

9 July 2020

Product data sheet

1. General description

P-channel enhancement mode Field-Effect Transistor (FET) in a medium power DFN2020MD-6 (SOT1220) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Extended temperature range $T_j = 175\text{ °C}$
- Side wettable flanks for optical solder inspection
- ElectroStatic Discharge (ESD) protection > 1 kV HBM (class H1C)
- Trench MOSFET technology
- AEC-Q101 qualified

3. Applications

- DC to DC conversion
- High-speed line driver
- High-side load switch
- Switching circuits

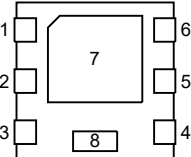
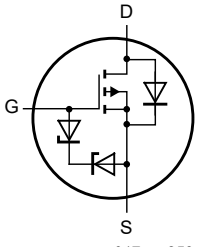
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j = 25\text{ °C}$	-	-	-20	V
V_{GS}	gate-source voltage		-12	-	12	V
I_D	drain current	$V_{GS} = -4.5\text{ V}; T_{sp} = 25\text{ °C}$	-	-	-18	A
P_{tot}	total power dissipation	$T_{sp} = 25\text{ °C}$	-	-	19	W
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = -4.5\text{ V}; I_D = -6\text{ A}; T_j = 25\text{ °C}$	-	30	38	m Ω

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	D	drain	 <p>Transparent top view DFN2020MD-6 (SOT1220)</p>	 <p>017aaa259</p>
2	D	drain		
3	G	gate		
4	S	source		
5	D	drain		
6	D	drain		
7	D	drain		
8	S	source		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK4D38-20P	DFN2020MD-6	plastic, leadless thermal enhanced ultra thin small outline package with side-wettable flanks (SWF); 6 terminals; 0.65 mm pitch; 2 mm x 2 mm x 0.65 mm body	SOT1220

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK4D38-20P	6F

8. Limiting values

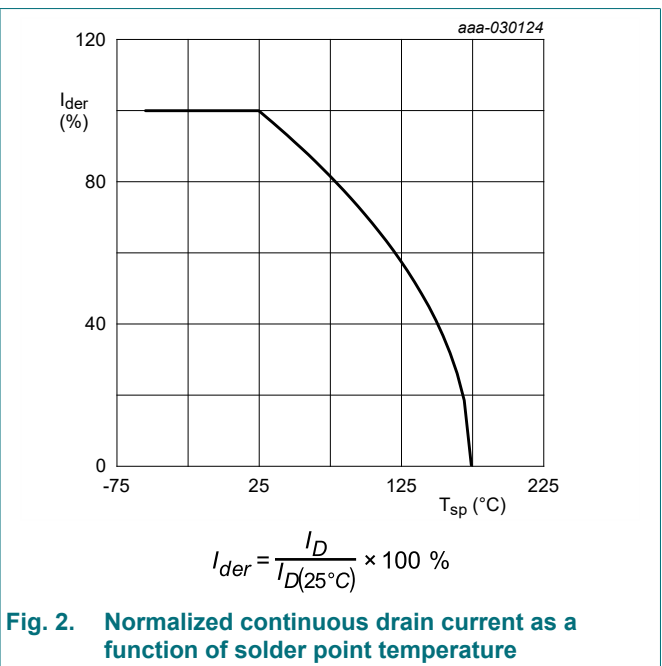
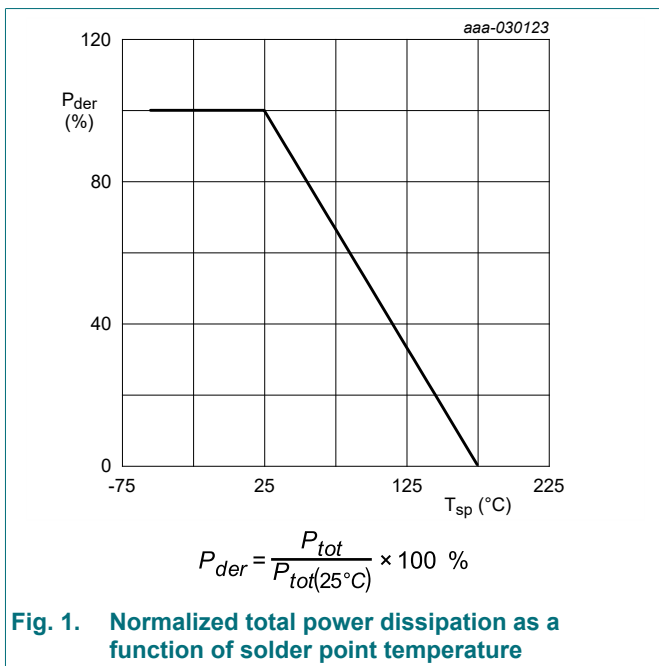
Table 5. Limiting values

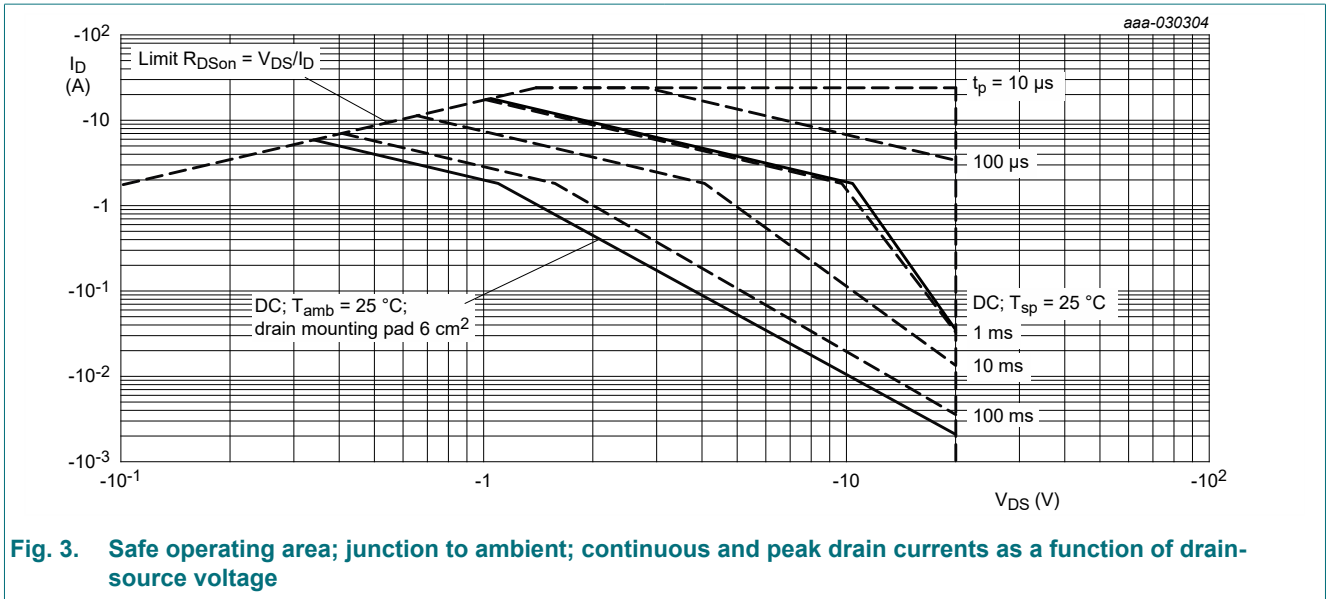
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{DS}	drain-source voltage	T _j = 25 °C	-	-20	V
V _{GS}	gate-source voltage		-12	12	V
I _D	drain current	V _{GS} = -4.5 V; T _{sp} = 25 °C	-	-18	A
		V _{GS} = -4.5 V; T _{sp} = 100 °C	-	-11	A
		V _{GS} = -4.5 V; T _{amb} = 25 °C	[1]	-6	A
I _{DM}	peak drain current	T _{sp} = 25 °C; single pulse; t _p ≤ 10 μs	-	-72	A
P _{tot}	total power dissipation	T _{sp} = 25 °C	-	19	W
		T _{amb} = 25 °C	[1]	2	W
T _j	junction temperature		-55	175	°C
T _{amb}	ambient temperature		-55	175	°C
T _{stg}	storage temperature		-65	175	°C
Source-drain diode					
I _S	source current	T _{sp} = 25 °C	-	-19	A
		T _{amb} = 25 °C	[1]	-2	A
I _{SM}	peak source current	single pulse; t _p ≤ 10 μs; T _{sp} = 25 °C	-	-75	A
ESD maximum rating					
V _{ESD}	electrostatic discharge voltage	HBM	[2]	1000	V
Avalanche ruggedness					
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	T _{j(init)} = 25 °C; I _D = 1.5 A; DUT in avalanche (unclamped)	-	15	mJ

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

[2] Measured between all pins.





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]	-	66	76	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	4	8	K/W

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

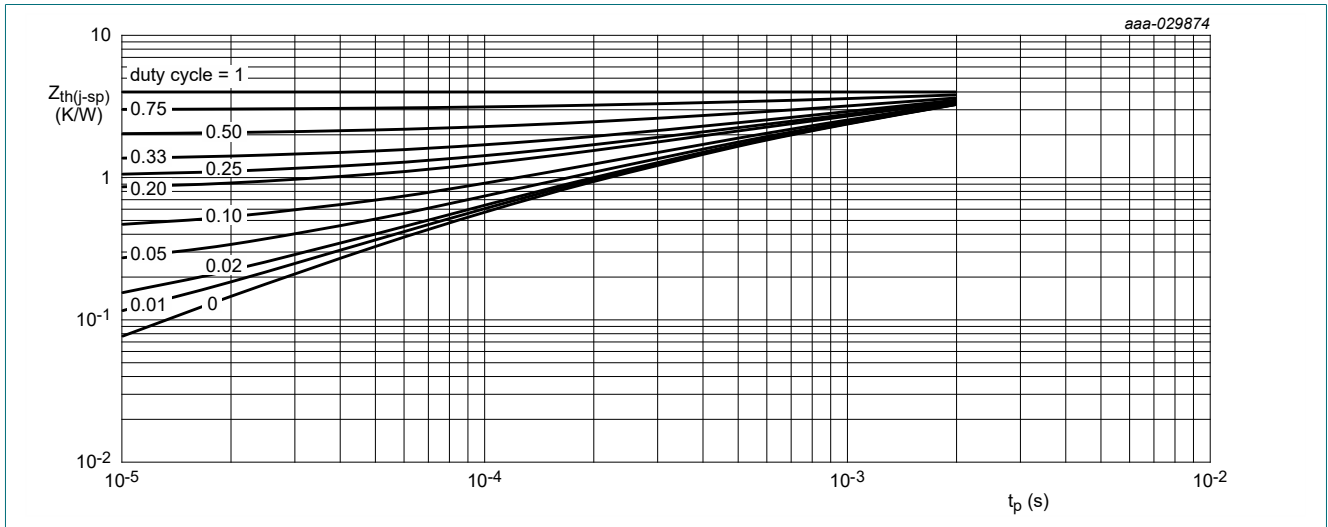


Fig. 4. Transient thermal impedance from junction to solder point as a function of pulse duration; typical values

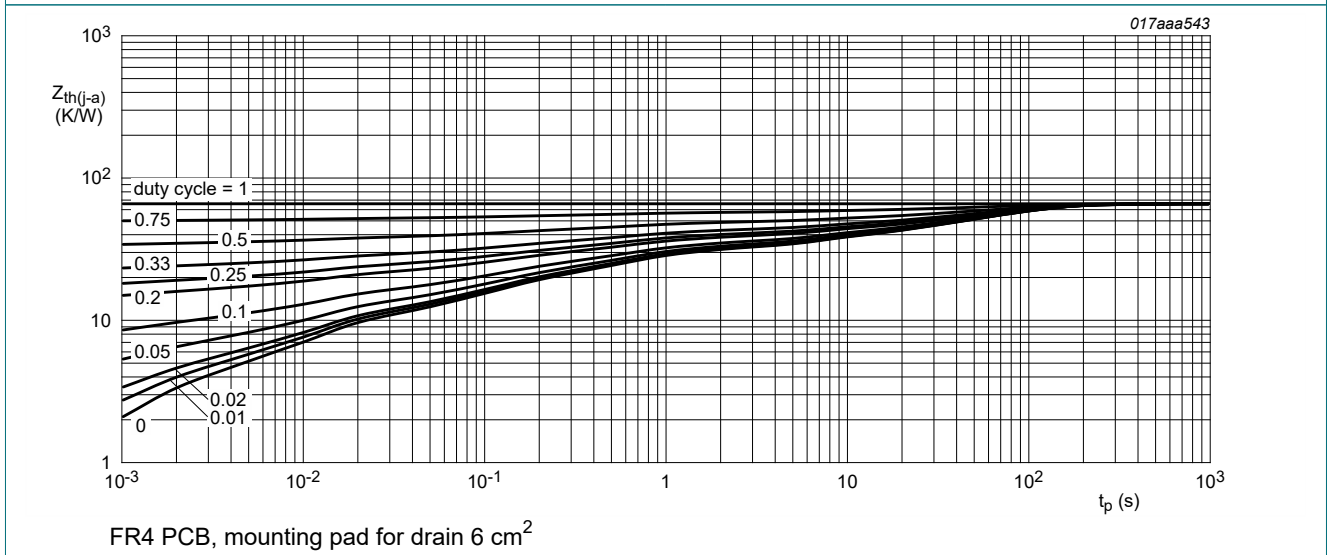


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = -250 \mu\text{A}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-20	-	-	V
V_{GSth}	gate-source threshold voltage	$I_D = -250 \mu\text{A}$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ }^\circ\text{C}$	-0.6	-0.95	-1.3	V
I_{DSS}	drain leakage current	$V_{DS} = -20 \text{ V}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-1	μA
		$V_{DS} = -20 \text{ V}$; $V_{GS} = 0 \text{ V}$; $T_j = 125 \text{ }^\circ\text{C}$	-	-	-20	μA
I_{GSS}	gate leakage current	$V_{GS} = -12 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-10	μA
		$V_{GS} = 12 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	10	μA
		$V_{GS} = -4.5 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	-2	μA
		$V_{GS} = 4.5 \text{ V}$; $V_{DS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-	2	μA
R_{DSon}	drain-source on-state resistance	$V_{GS} = -8 \text{ V}$; $I_D = -6 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$	-	26	33	m Ω
		$V_{GS} = -8 \text{ V}$; $I_D = -6 \text{ A}$; $T_j = 175 \text{ }^\circ\text{C}$	-	40	50	m Ω
		$V_{GS} = -4.5 \text{ V}$; $I_D = -6 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$	-	30	38	m Ω
		$V_{GS} = -2.5 \text{ V}$; $I_D = -2 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$	-	46	64	m Ω
g_{fs}	forward transconductance	$V_{DS} = -10 \text{ V}$; $I_D = -6 \text{ A}$; $T_j = 25 \text{ }^\circ\text{C}$	-	20	-	S
R_G	gate resistance	$f = 1 \text{ MHz}$	-	21	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$V_{DS} = -10 \text{ V}$; $I_D = -5.8 \text{ A}$; $V_{GS} = -4.5 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	10.6	16	nC
Q_{GS}	gate-source charge		-	2.1	-	nC
Q_{GD}	gate-drain charge		-	3.6	-	nC
C_{iss}	input capacitance	$V_{DS} = -10 \text{ V}$; $f = 1 \text{ MHz}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	1025	-	pF
C_{oss}	output capacitance		-	137	-	pF
C_{rss}	reverse transfer capacitance		-	113	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = -10 \text{ V}$; $I_D = -5.8 \text{ A}$; $V_{GS} = -4.5 \text{ V}$; $R_{G(ext)} = 6 \text{ } \Omega$; $T_j = 25 \text{ }^\circ\text{C}$	-	6	-	ns
t_r	rise time		-	17	-	ns
$t_{d(off)}$	turn-off delay time		-	23	-	ns
t_f	fall time		-	19	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = -2 \text{ A}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	-0.8	-1.2	V
t_{rr}	reverse recovery time	$I_S = -2 \text{ A}$; $dI_S/dt = 100 \text{ A}/\mu\text{s}$; $V_{GS} = 0 \text{ V}$; $V_{DS} = -10 \text{ V}$; $T_j = 25 \text{ }^\circ\text{C}$	-	17	-	ns
Q_r	recovered charge		-	5	-	nC

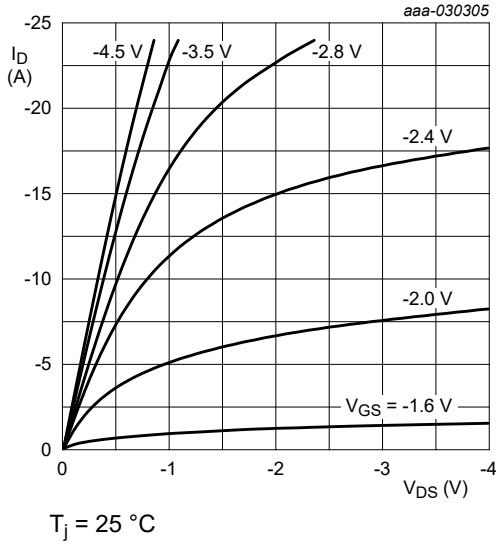


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

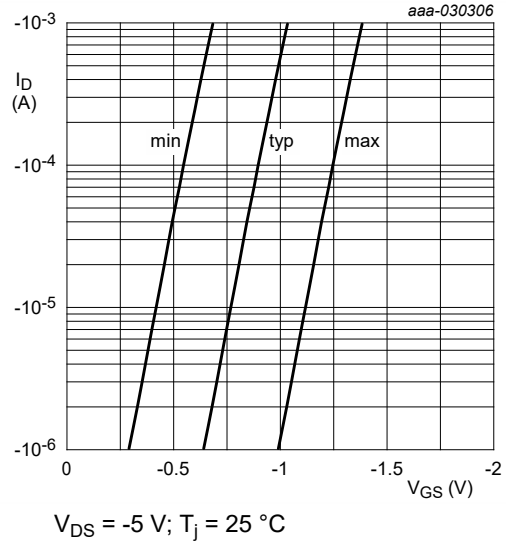


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

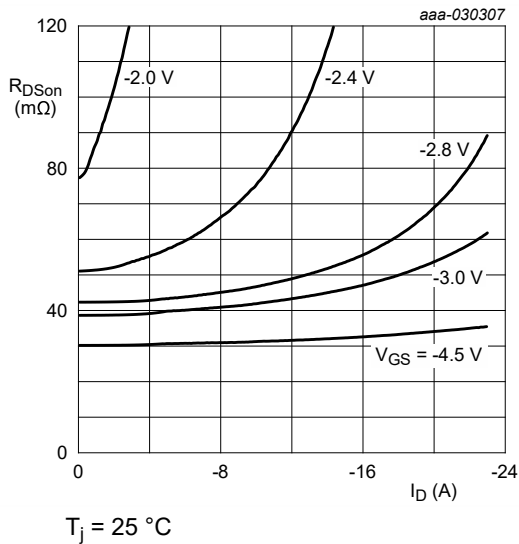


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

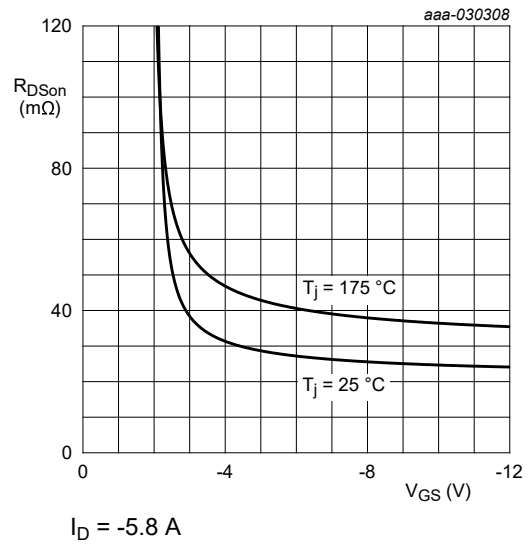


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

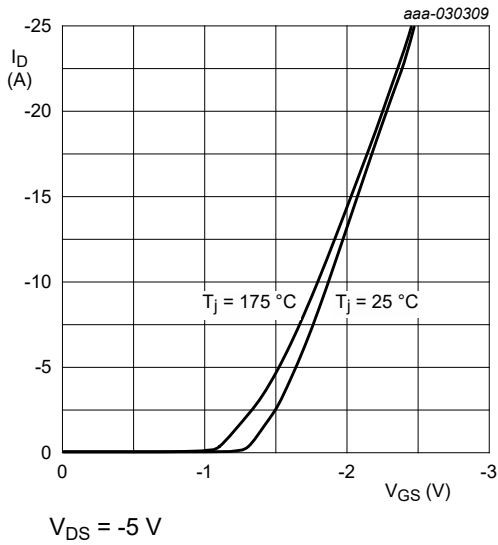


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

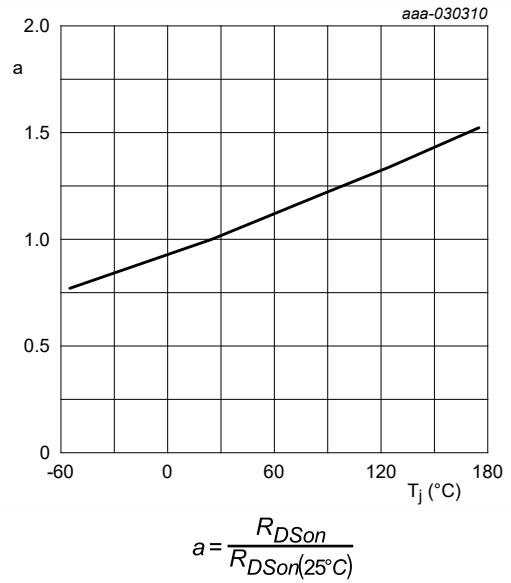


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

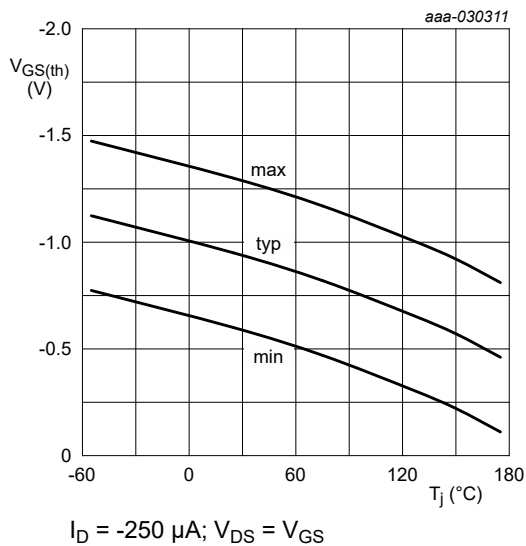


Fig. 12. Gate-source threshold voltage as a function of junction temperature

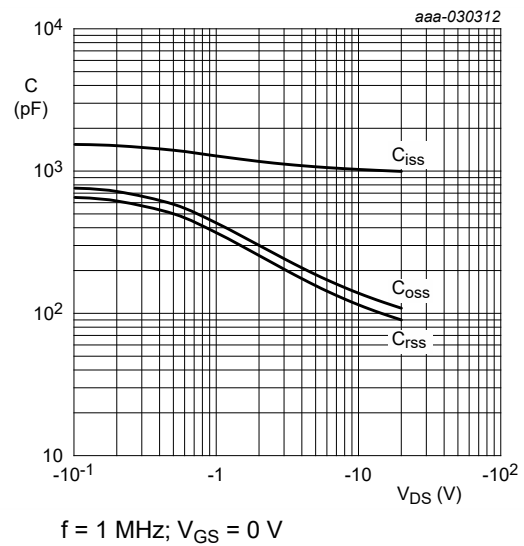
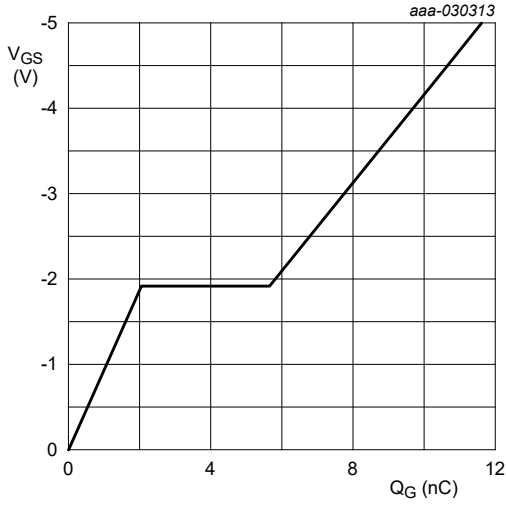


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$I_D = -5.8 \text{ A}; V_{DS} = -10 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$

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

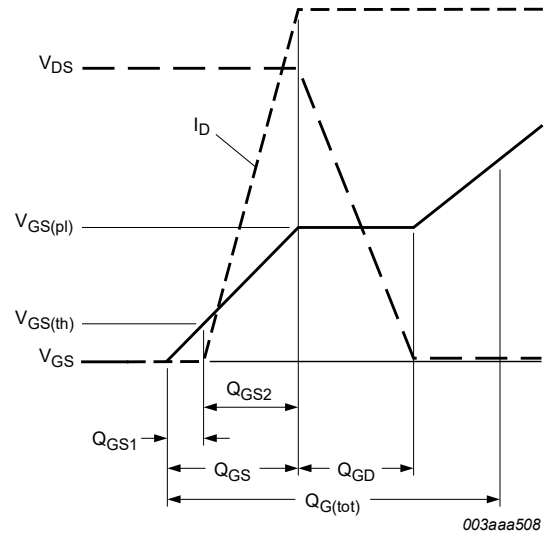
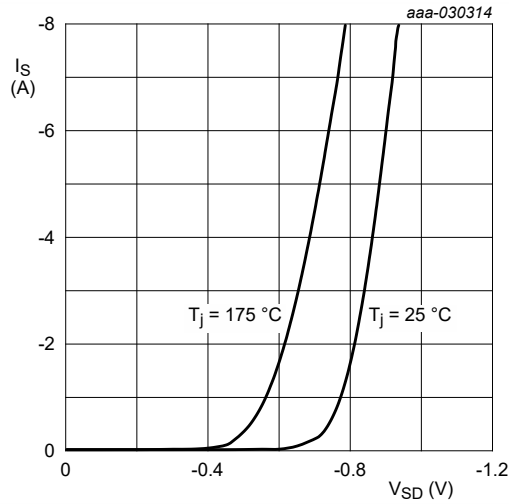


Fig. 15. Gate charge waveform definitions



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

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

11. Test information

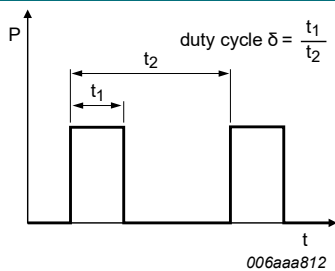


Fig. 17. Duty cycle definition

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

DFN2020MD-6: plastic thermal enhanced ultra thin small outline package; no leads;
6 terminals; body 2 x 2 x 0.65 mm

SOT1220

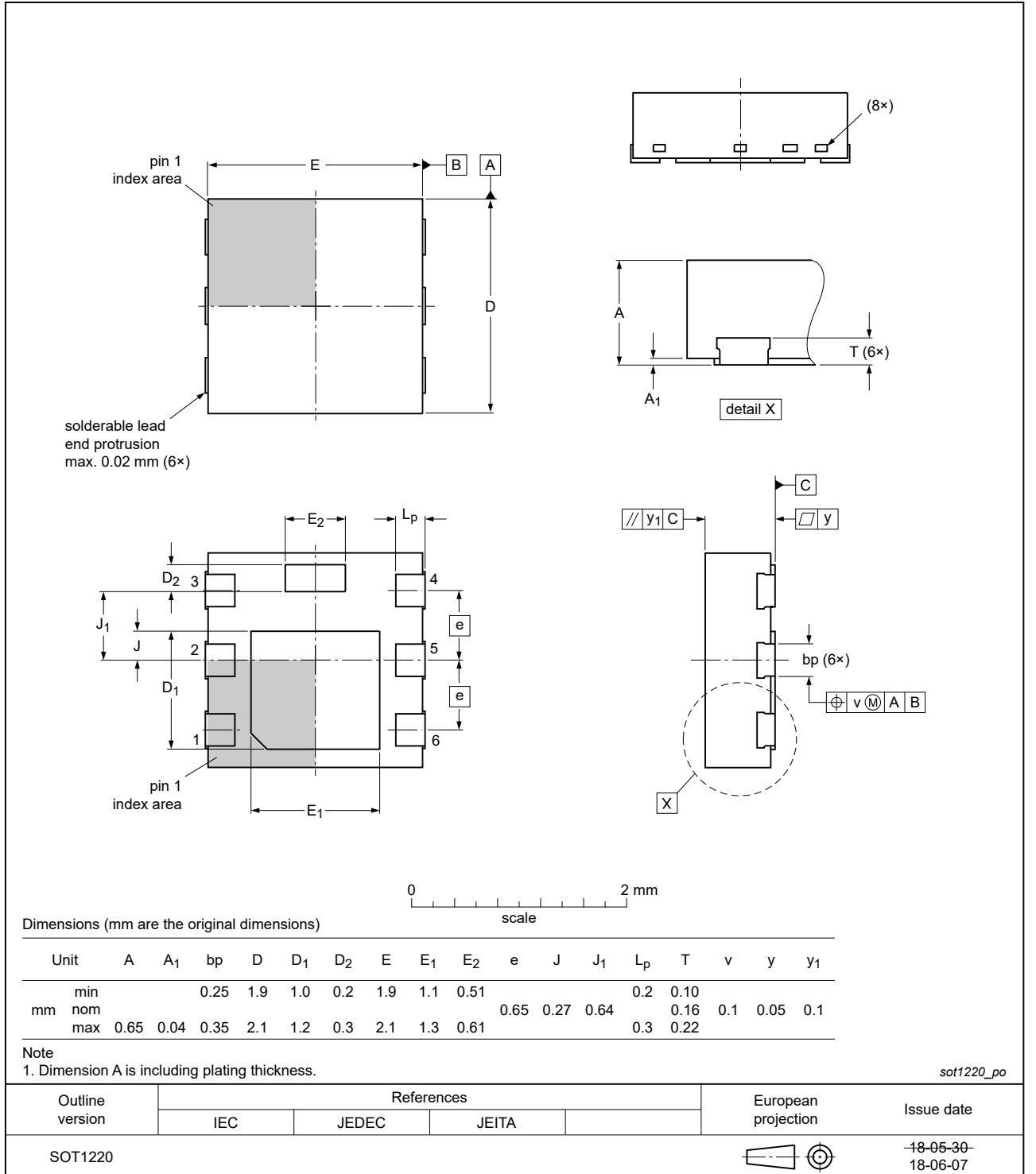


Fig. 18. Package outline DFN2020MD-6 (SOT1220)

13. Soldering

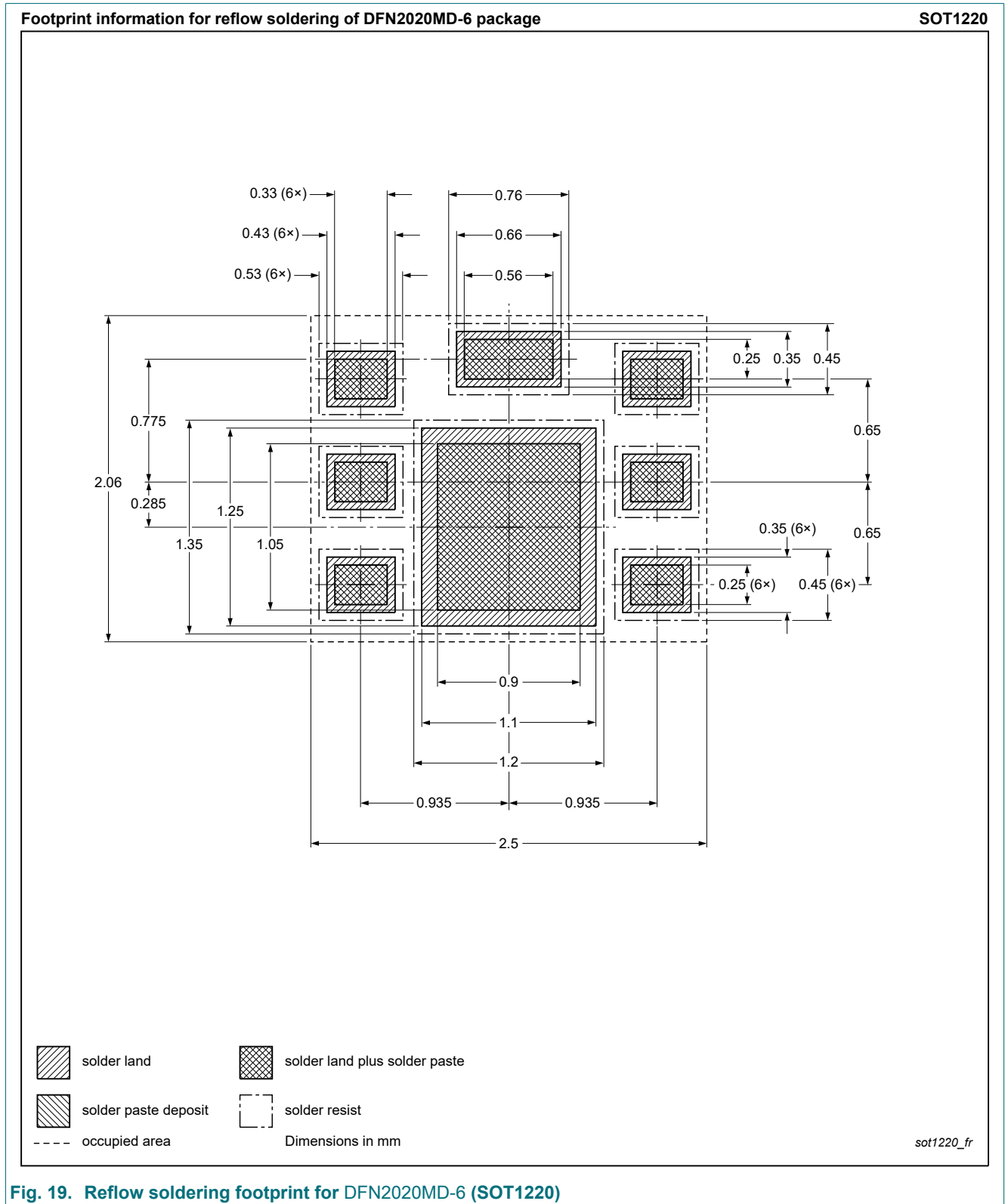


Fig. 19. Reflow soldering footprint for DFN2020MD-6 (SOT1220)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
BUK4D38-20P v.3	20200709	Product data sheet	-	BUK4D38-20P v.2
Modifications:	• Product status changed.			
BUK4D38-20P v.2	20200121	Objective data sheet	-	BUK4D38-20P v.1
BUK4D38-20P v.1	20191025	Objective 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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