



BUK6D120-40E

40 V, N-channel Trench MOSFET

29 April 2019

Product data sheet

1. General description

N-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 $> 1\text{ kV HBM (class H1C)}$
- Trench MOSFET technology
- AEC-Q101 qualified

3. Applications

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

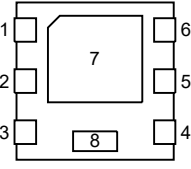
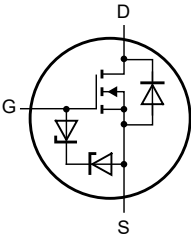
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j = 25\text{ °C}$	-	-	40	V
V_{GS}	gate-source voltage		-20	-	20	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{sp} = 25\text{ °C}$	-	-	5.7	A
P_{tot}	total power dissipation	$T_{sp} = 25\text{ °C}$	-	-	7.5	W
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 2.9\text{ A}; T_j = 25\text{ °C}$	-	85	120	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>017aaa255</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
BUK6D120-40E	DFN2020MD-6	plastic, leadless thermal enhanced ultra thin small outline package; 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
BUK6D120-40E	5F

8. Limiting values

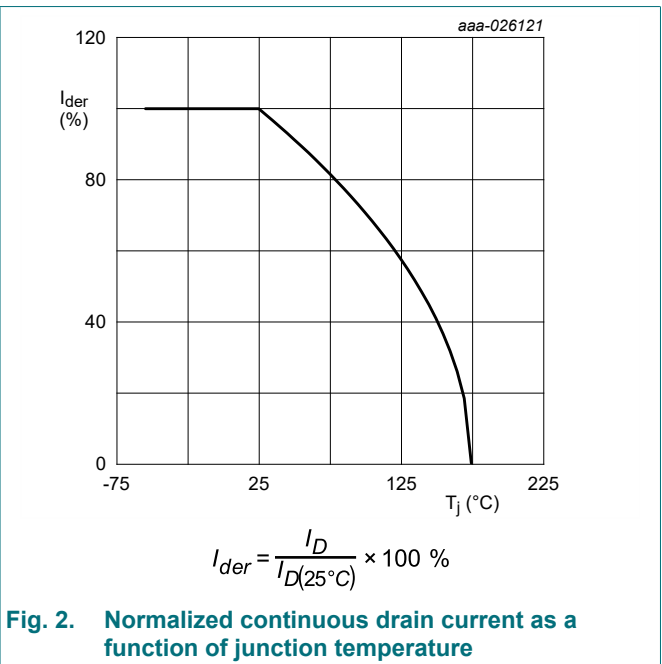
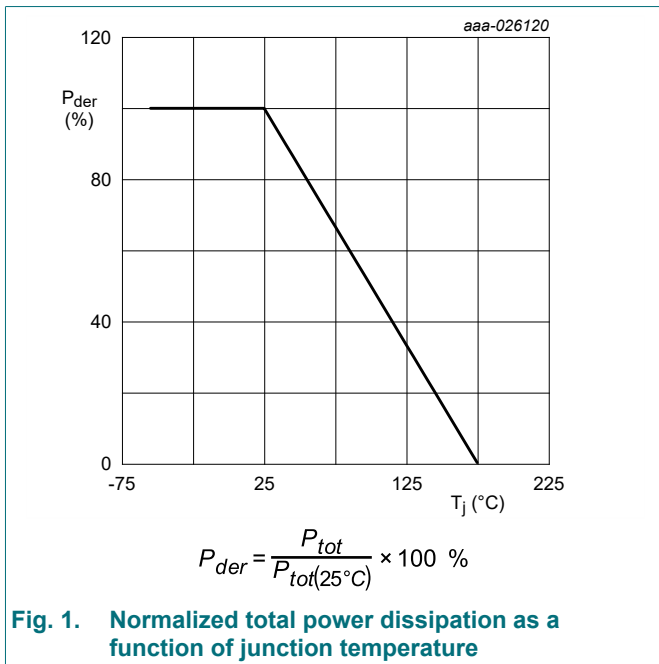
Table 5. Limiting values

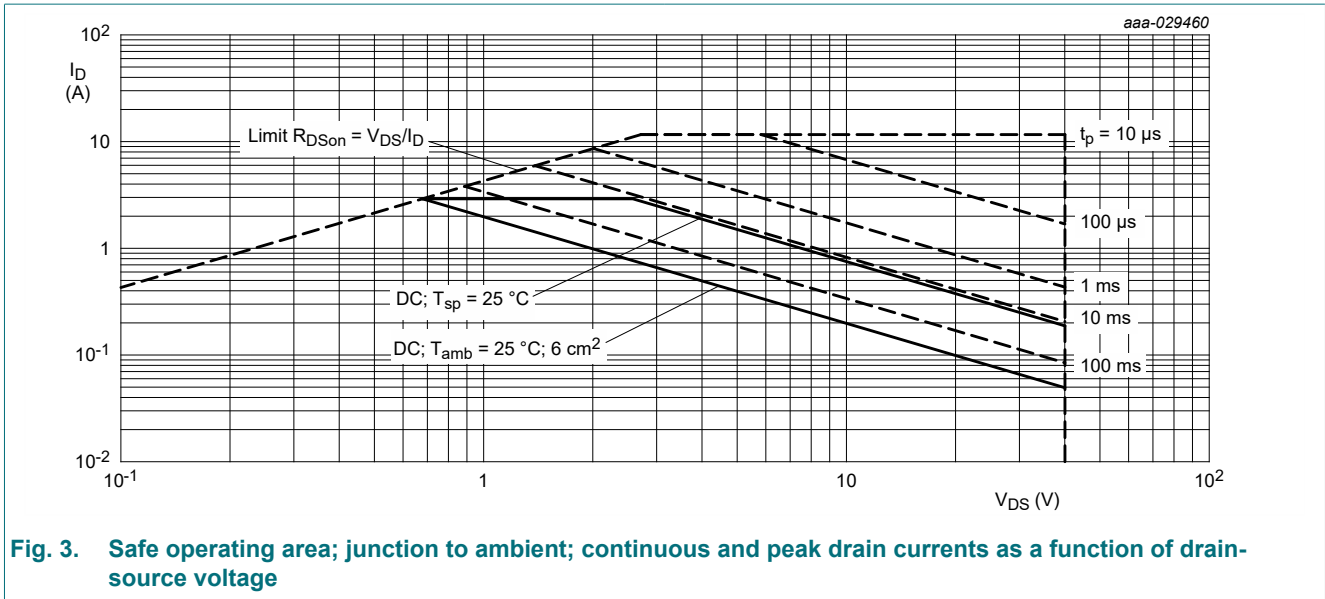
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{DS}	drain-source voltage	T _j = 25 °C	-	40	V
V _{GS}	gate-source voltage		-20	20	V
I _D	drain current	V _{GS} = 10 V; T _{sp} = 25 °C	-	5.7	A
		V _{GS} = 10 V; T _{sp} = 100 °C	-	3.6	A
		V _{GS} = 10 V; T _{amb} = 25 °C	[1]	2.9	A
I _{DM}	peak drain current	T _{sp} = 25 °C; single pulse; t _p ≤ 10 μs	-	23	A
P _{tot}	total power dissipation	T _{sp} = 25 °C	-	7.5	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	-	5.7	A
		T _{amb} = 25 °C	[1]	2	A
I _{SM}	peak source current	single pulse; t _p ≤ 10 μs; T _{sp} = 25 °C	-	23	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 = 0.26 A; DUT in avalanche (unclamped)	-	5.8	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			-	15	20	K/W

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

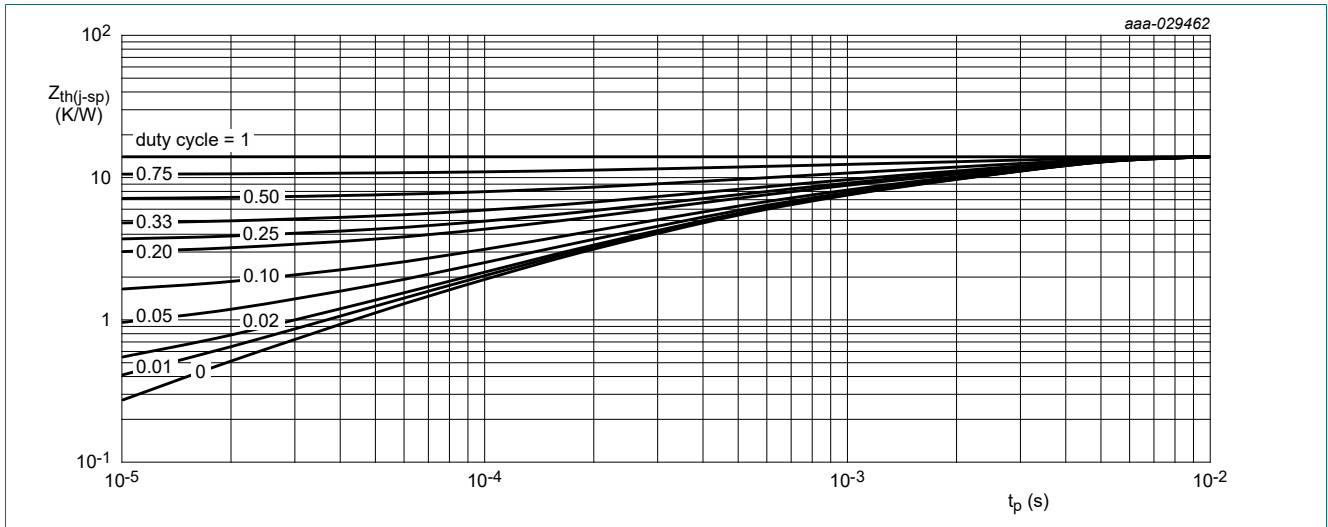


Fig. 4. Transient thermal impedance from junction to solder point as a function of pulse duration; typical values

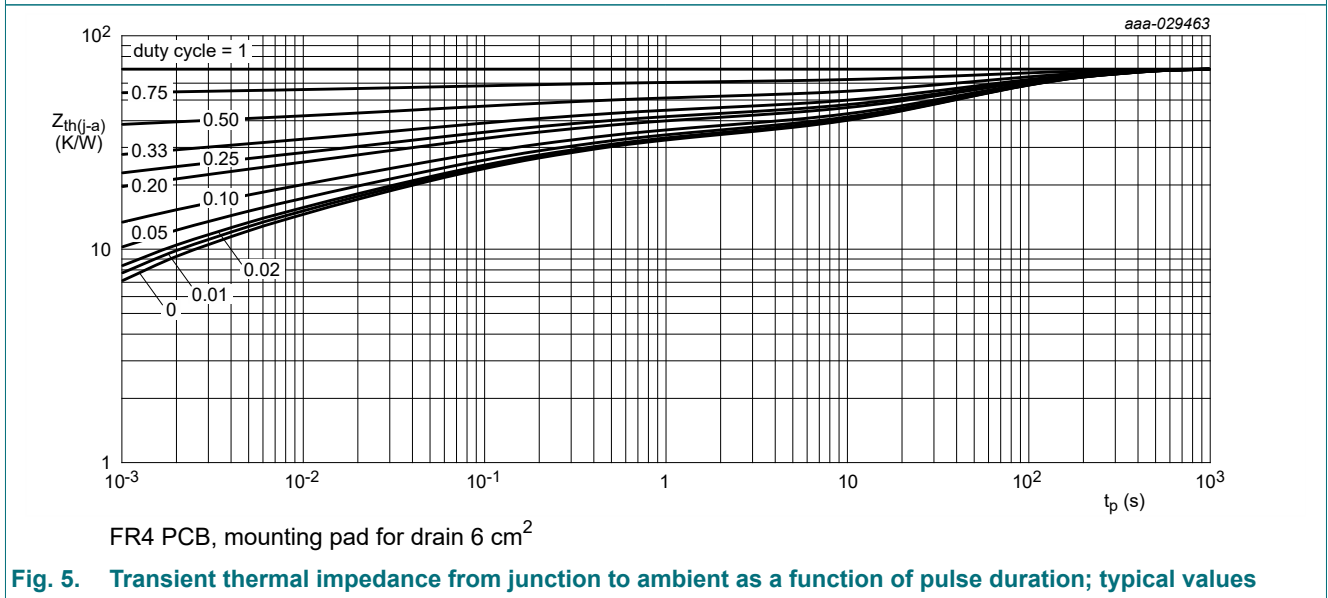


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_j = 25 ^\circ C$	40	-	-	V
V_{GSth}	gate-source threshold voltage	$I_D = 250 \mu A$; $V_{DS} = V_{GS}$; $T_j = 25 ^\circ C$	1	1.6	2.5	V
I_{DSS}	drain leakage current	$V_{DS} = 40 V$; $V_{GS} = 0 V$; $T_j = 25 ^\circ C$	-	-	1	μA
		$V_{DS} = 40 V$; $V_{GS} = 0 V$; $T_j = 125 ^\circ C$	-	-	4	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 V$; $V_{DS} = 0 V$; $T_j = 25 ^\circ C$	-	-	10	μA
		$V_{GS} = -20 V$; $V_{DS} = 0 V$; $T_j = 25 ^\circ C$	-	-	-10	μA
		$V_{GS} = 10 V$; $V_{DS} = 0 V$; $T_j = 25 ^\circ C$	-	-	1	μA
		$V_{GS} = -10 V$; $V_{DS} = 0 V$; $T_j = 25 ^\circ C$	-	-	-1	μA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 V$; $I_D = 2.9 A$; $T_j = 25 ^\circ C$	-	85	120	m Ω
		$V_{GS} = 10 V$; $I_D = 2.9 A$; $T_j = 175 ^\circ C$	-	165	233	m Ω
		$V_{GS} = 4.5 V$; $I_D = 2.5 A$; $T_j = 25 ^\circ C$	-	112	160	m Ω
g_{fs}	forward transconductance	$V_{DS} = 10 V$; $I_D = 2 A$; $T_j = 25 ^\circ C$	-	4.5	-	S
R_G	gate resistance	$f = 1 MHz$	-	28	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 20 V$; $I_D = 2.9 A$; $V_{GS} = 10 V$; $T_j = 25 ^\circ C$	-	2.4	3.6	nC
Q_{GS}	gate-source charge		-	0.3	-	nC
Q_{GD}	gate-drain charge		-	0.4	-	nC
C_{iss}	input capacitance	$V_{DS} = 20 V$; $f = 1 MHz$; $V_{GS} = 0 V$; $T_j = 25 ^\circ C$	-	113	-	pF
C_{oss}	output capacitance		-	27	-	pF
C_{rss}	reverse transfer capacitance		-	14	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20 V$; $I_D = 2.9 A$; $V_{GS} = 10 V$; $R_{G(ext)} = 6 \Omega$; $T_j = 25 ^\circ C$	-	6	-	ns
t_r	rise time		-	8	-	ns
$t_{d(off)}$	turn-off delay time		-	11	-	ns
t_f	fall time		-	3	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 2 A$; $V_{GS} = 0 V$; $T_j = 25 ^\circ C$	-	0.8	1.2	V
t_{rr}	reverse recovery time	$I_S = 1 A$; $di_S/dt = -100 A/\mu s$; $V_{GS} = 0 V$;	-	7.2	-	ns
Q_r	recovered charge	$V_{DS} = 20 V$; $T_j = 25 ^\circ C$	-	3	-	nC

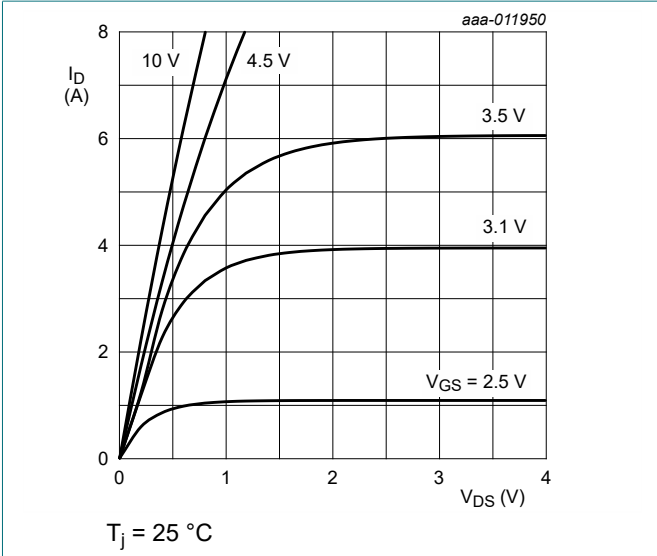


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

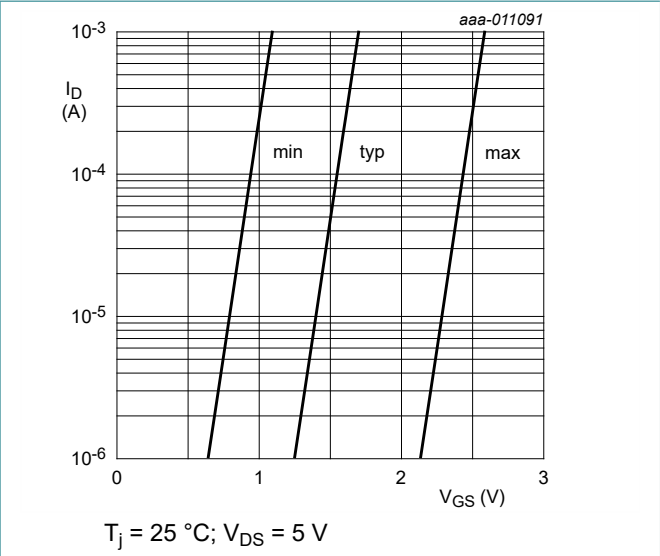


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

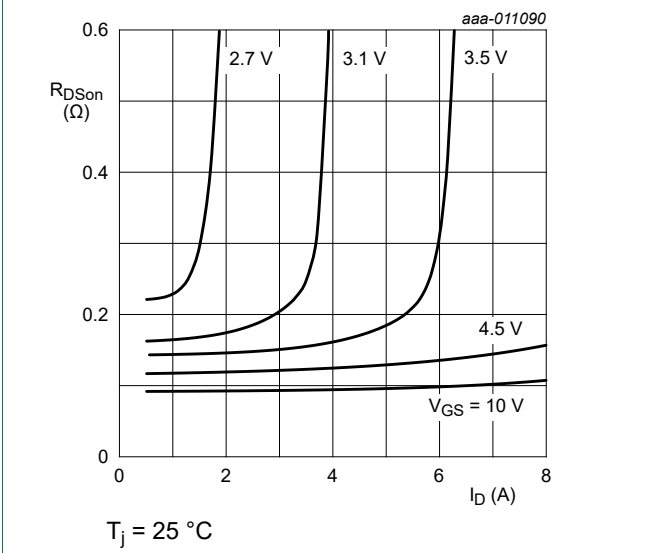


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

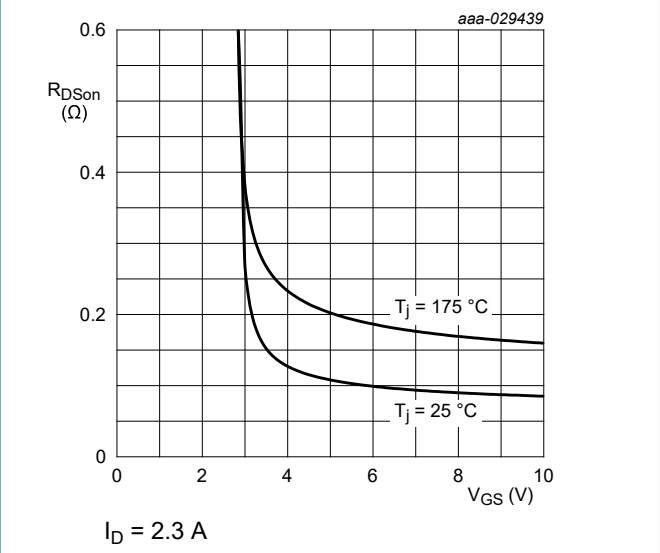
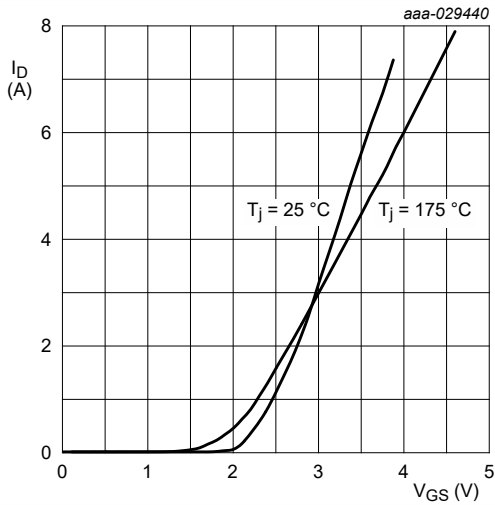
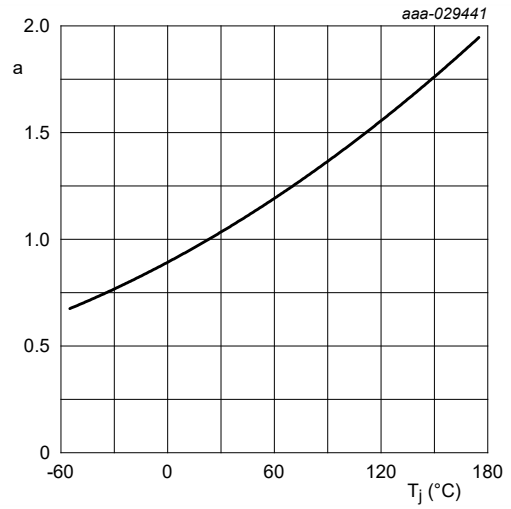


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



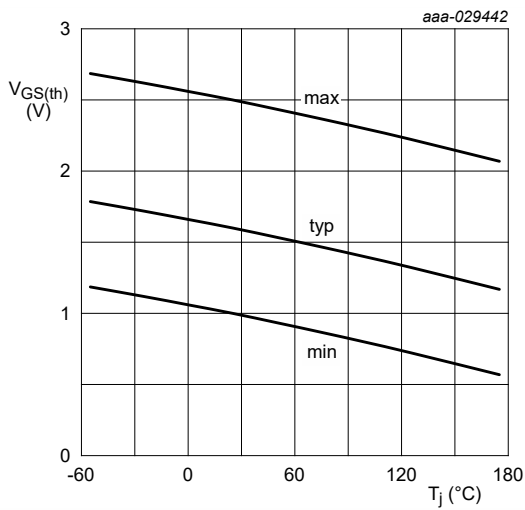
$$V_{DS} > I_D \times R_{DSon}$$

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



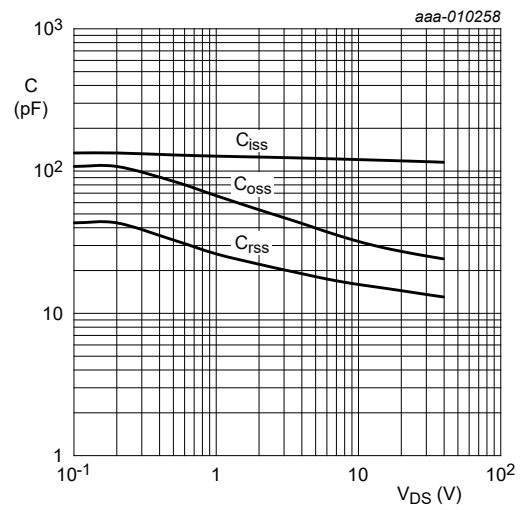
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

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



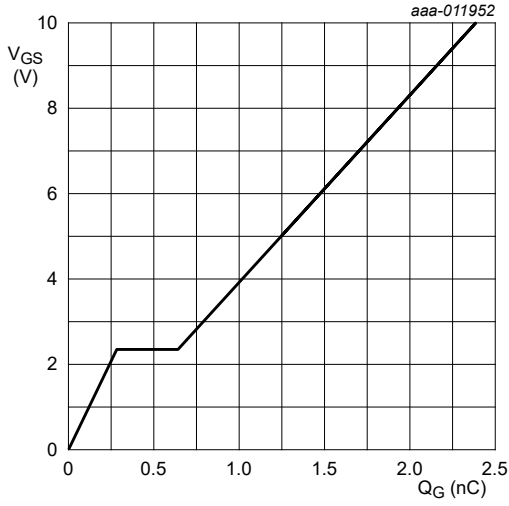
$$I_D = 250\mu A; V_{DS} = V_{GS}$$

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



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

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



$I_D = 1.5$ A; $V_{DS} = 20$ V; $T_{amb} = 25$ °C

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

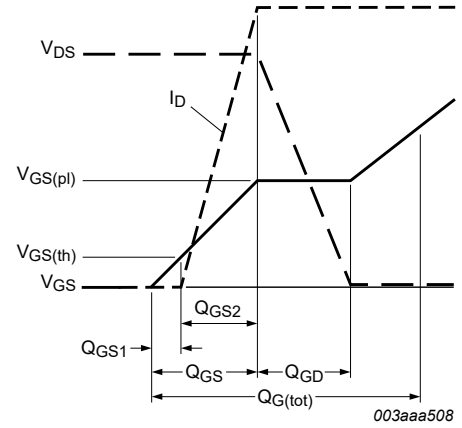
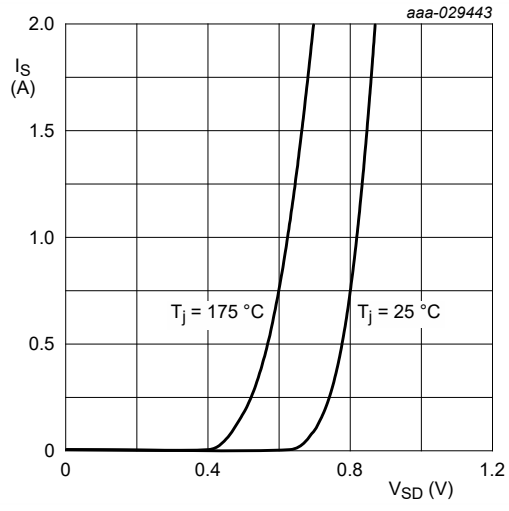


Fig. 15. Gate charge waveform definitions



$V_{GS} = 0$ V

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

11. Test information

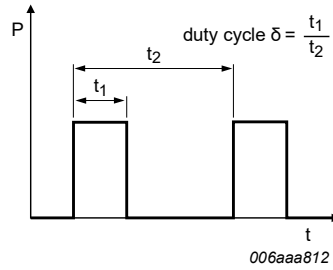


Fig. 17. Duty cycle definition

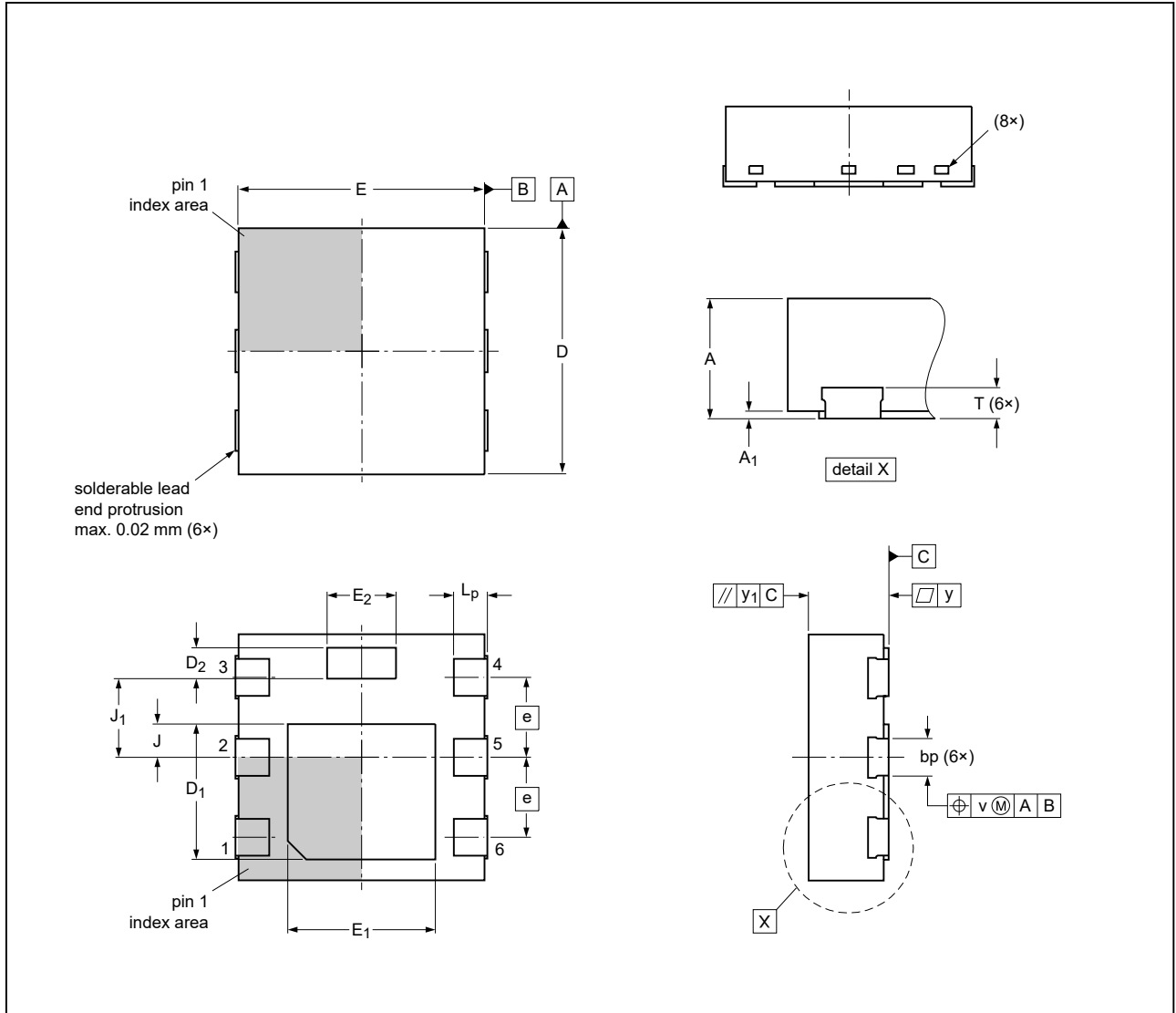
Quality information

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



Dimensions (mm are the original dimensions)

Unit	A	A ₁	bp	D	D ₁	D ₂	E	E ₁	E ₂	e	J	J ₁	L _p	T	v	y	y ₁	
mm	min		0.25	1.9	1.0	0.2	1.9	1.1	0.51		0.65	0.27	0.64	0.2	0.10			
	nom																	
	max	0.65	0.04	0.35	2.1	1.2	0.3	2.1	1.3	0.61			0.3	0.22	0.16	0.1	0.05	0.1

Note

1. Dimension A is including plating thickness.

sot1220_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1220						18-05-30 18-06-07

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

13. Soldering

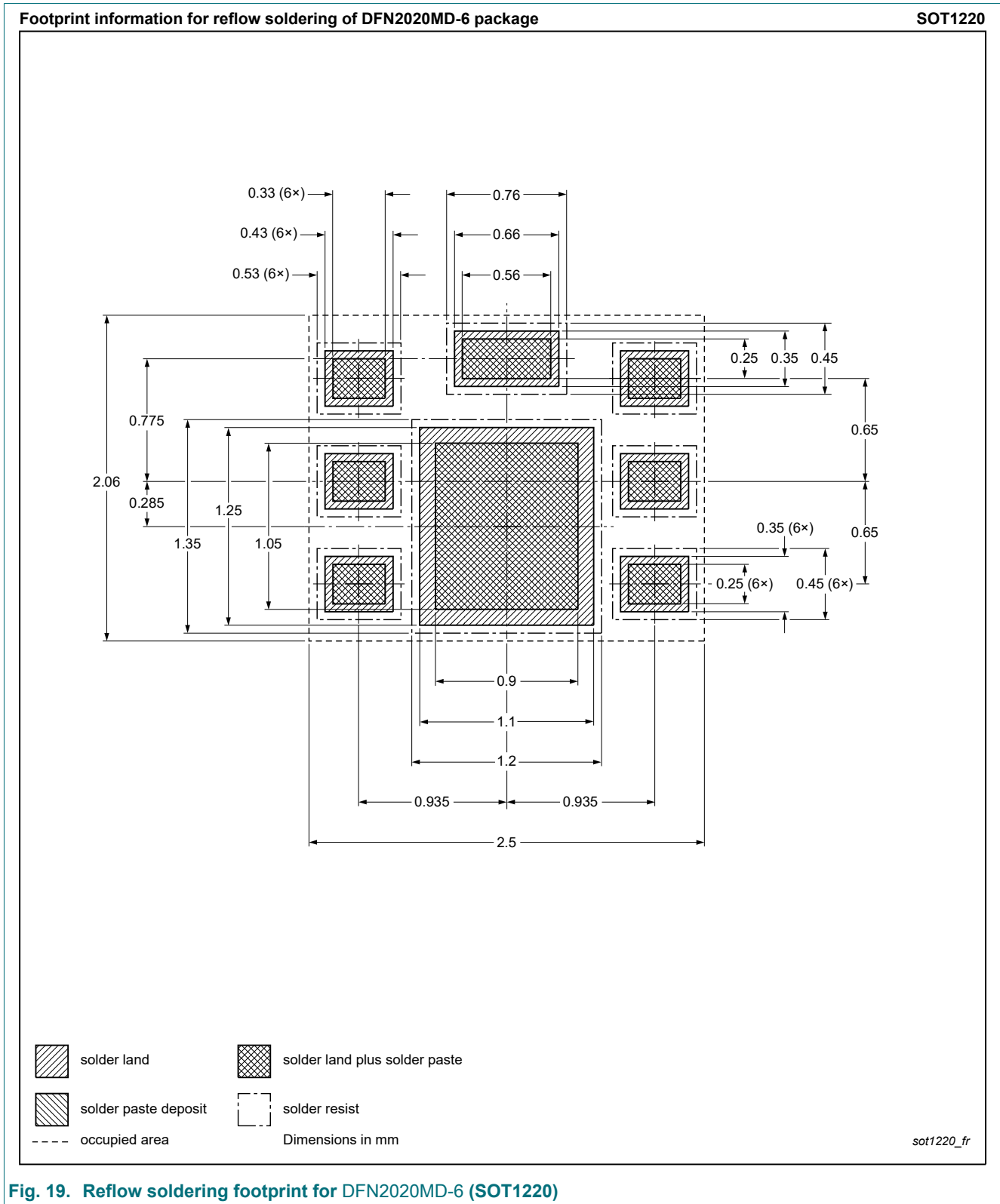


Fig. 19. Reflow soldering footprint for DFN2020MD-6 (SOT1220)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
BUK6D120-40E v.1	20190429	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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