



2N7002KQB

60 V N-channel Trench MOSFET

22 September 2021

Product data sheet

1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in an ultra small DFN1110D-3 (SOT8015) leadless Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Logic-level compatible
- Side wettable flanks for optical solder inspection
- Ultra small and leadless SMD plastic package: 1.1 x 1 x 0.48 mm
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection > 1 kV HBM (Class H1C)
- AEC-Q101 qualified

3. Applications

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

4. Quick reference data

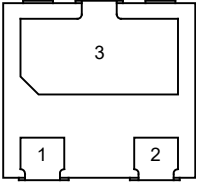
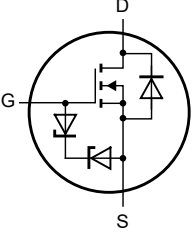
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j = 25\text{ }^{\circ}\text{C}$		-	-	60	V
V_{GS}	gate-source voltage			-16	-	16	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$	[1]	-	-	720	mA
Static characteristics							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 720\text{ mA}; T_j = 25\text{ }^{\circ}\text{C}$		-	635	850	m Ω

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

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 Transparent top view DFN1110D-3 (SOT8015)	 017aaa255
2	S	source		
3	D	drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
2N7002KQB	DFN1110D-3	plastic, leadless extremely thin small outline package with side-wettable flanks (SWF); 3 terminals; 0.65 mm pitch; 1.1 mm x 1 mm x 0.48 mm body	SOT8015

7. Marking

Table 4. Marking codes

Type number	Marking code
2N7002KQB	C7

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			-16	16	V
V _{GSMlim}	peak gate-source voltage	δ _{factor} = 0.1; t _p = 50 μs; T _j = 25 °C		-20	20	V
I _D	drain current	V _{GS} = 10 V; T _{amb} = 25 °C	[1]	-	720	mA
		V _{GS} = 10 V; T _{amb} = 100 °C	[1]	-	460	mA
I _{DM}	peak drain current	T _{amb} = 25 °C; single pulse; t _p ≤ 10 μs		-	2.9	A
P _{tot}	total power dissipation	T _{amb} = 25 °C	[2]	-	420	mW
			[1]	-	960	mW
		T _{sp} = 25 °C		-	4.2	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]	-	700	mA
ESD maximum rating						
V _{ESD}	electrostatic discharge voltage	HBM		-	1000	V
Avalanche ruggedness						
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	T _{j(initial)} = 25 °C; I _D = 0.05 A		-	1.5	mJ

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

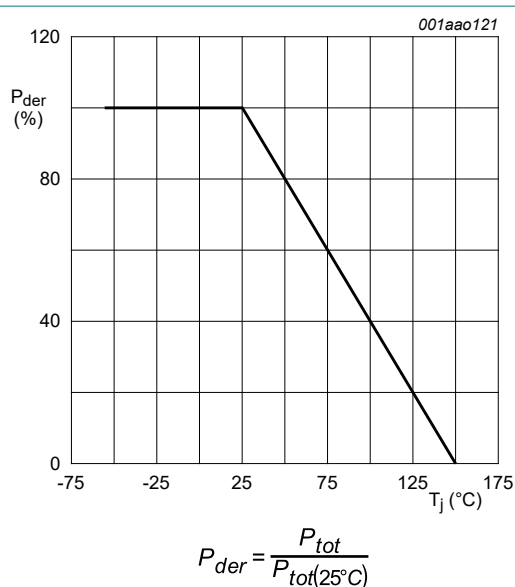


Fig. 1. Normalized total power dissipation as a function of junction temperature

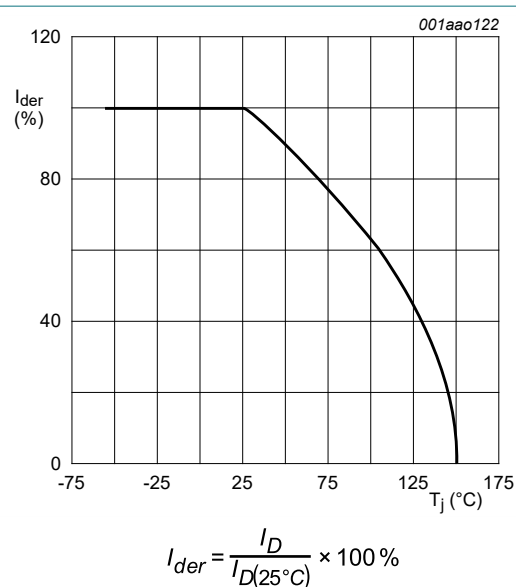


Fig. 2. Normalized continuous drain current as a function of junction temperature

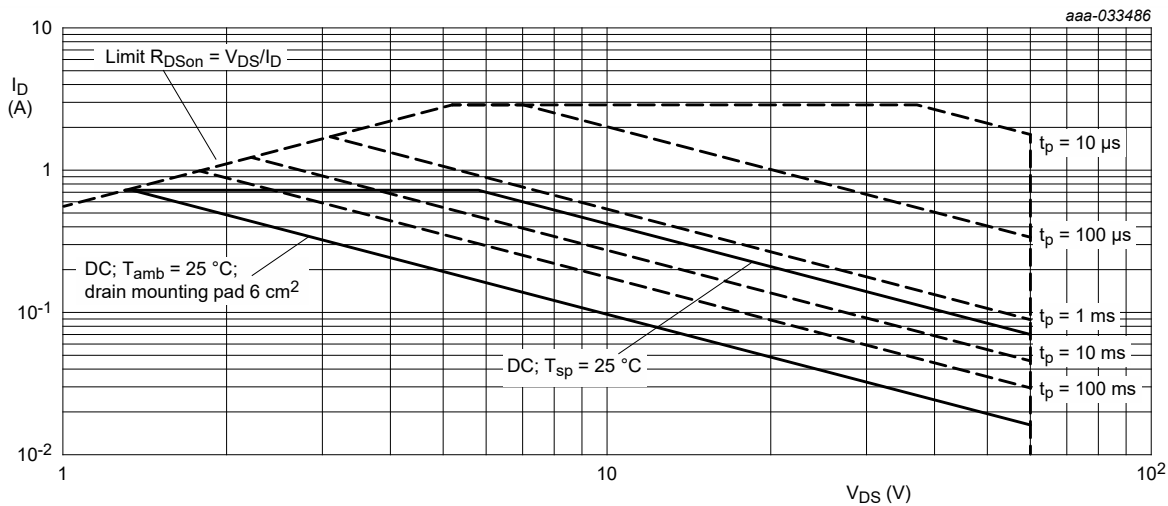


Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

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]	-	245	300	K/W
			[2]	-	110	130	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	25	30	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 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm².

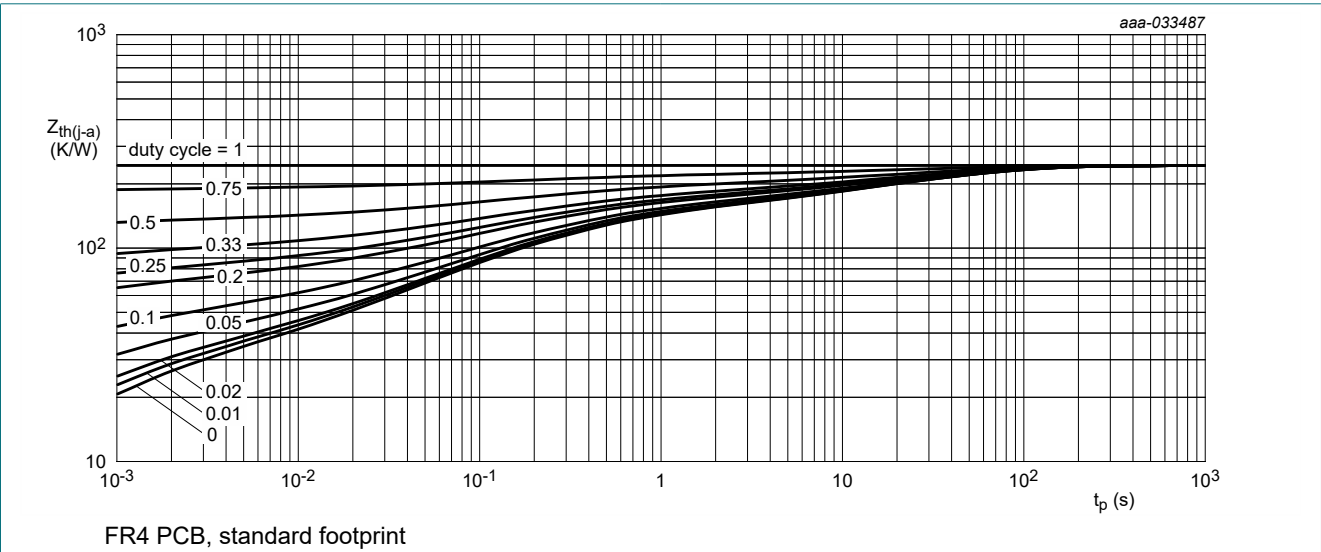


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

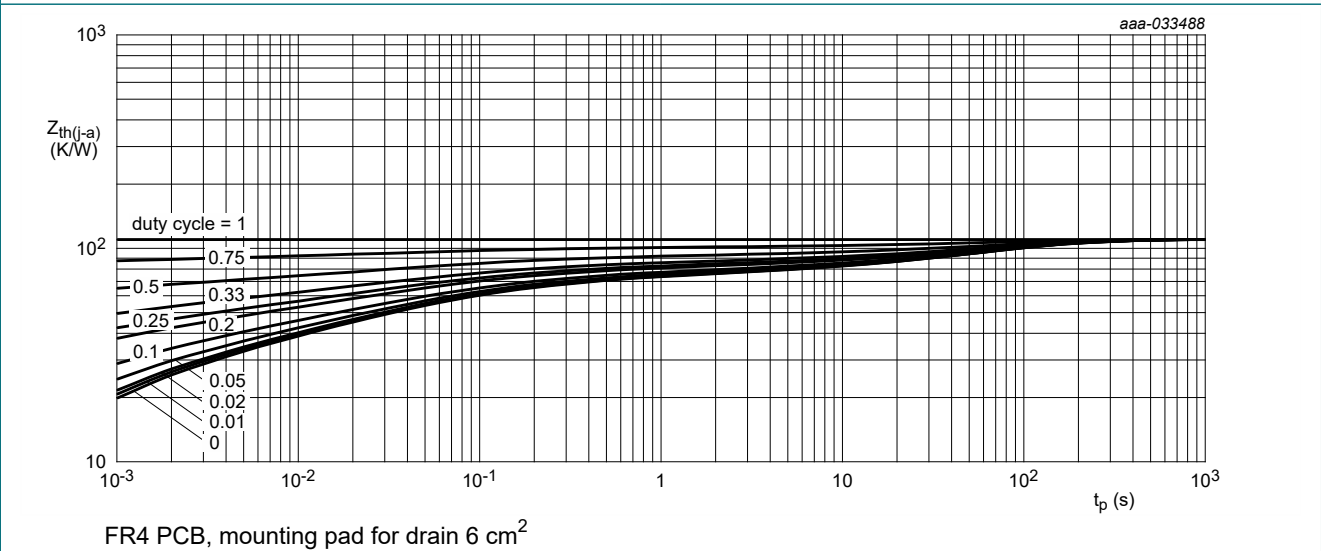


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
V _{(BR)DSS}	drain-source breakdown voltage	I _D = 250 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		1.3	1.7	2.6	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} = 16 V; V _{DS} = 0 V; T _j = 25 °C		-	-	10	μA
		V _{GS} = -16 V; V _{DS} = 0 V; T _j = 25 °C		-	-	-10	μA
R _{DSon}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 720 mA; T _j = 25 °C		-	635	850	mΩ
		V _{GS} = 10 V; I _D = 720 mA; T _j = 150 °C		-	1400	1800	mΩ
		V _{GS} = 4.5 V; I _D = 630 mA; T _j = 25 °C		-	765	1100	mΩ
g _{fs}	forward transconductance	V _{DS} = 5 V; I _D = 720 mA; T _j = 25 °C		-	1.1	-	S
Dynamic characteristics							
Q _{G(tot)}	total gate charge	V _{DS} = 30 V; I _D = 0.7 A; V _{GS} = 10 V; T _j = 25 °C		-	0.61	0.92	nC
Q _{GS}	gate-source charge			-	0.07	-	nC
Q _{GD}	gate-drain charge			-	0.15	-	nC
C _{iss}	input capacitance	V _{DS} = 30 V; f = 1 MHz; V _{GS} = 0 V; T _j = 25 °C		-	28	-	pF
C _{oss}	output capacitance			-	5	-	pF
C _{rss}	reverse transfer capacitance			-	3	-	pF
t _{d(on)}	turn-on delay time	V _{DS} = 30 V; I _D = 0.7 A; V _{GS} = 10 V; R _{G(ext)} = 6 Ω; T _j = 25 °C		-	1	-	ns
t _r	rise time			-	1	-	ns
t _{d(off)}	turn-off delay time			-	6	-	ns
t _f	fall time			-	3	-	ns
Source-drain diode							
V _{SD}	source-drain voltage	I _S = 0.7 A; V _{GS} = 0 V; T _j = 25 °C		-	0.7	1.2	V
t _{rr}	reverse recovery time	I _S = 0.7 A; dI _S /dt = -100 A/s; V _{GS} = 10 V; V _{DS} = 30 V; T _j = 25 °C		-	8	-	ns
Q _r	recovered charge	I _S = 0.7 A; dI _S /dt = -100 A/μs; V _{GS} = 10 V; V _{DS} = 30 V; T _j = 25 °C		-	2	-	nC

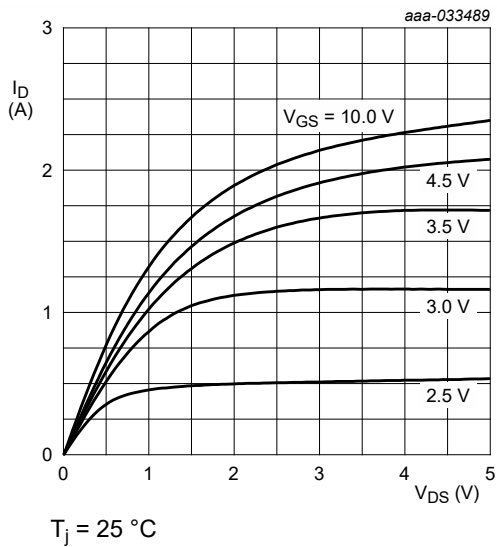


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

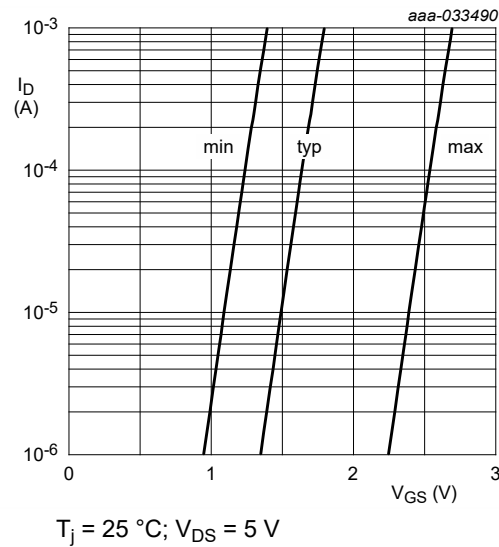


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

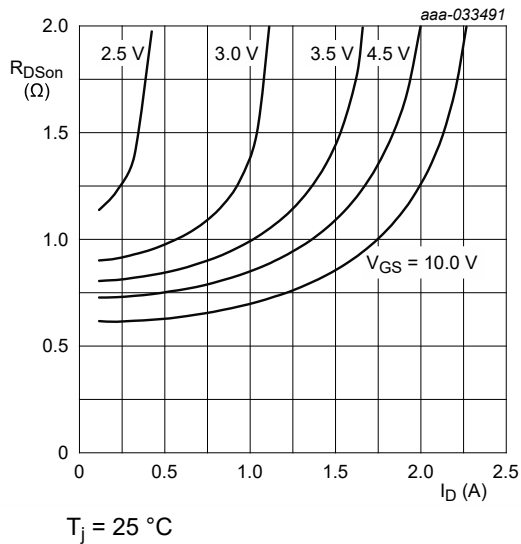


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

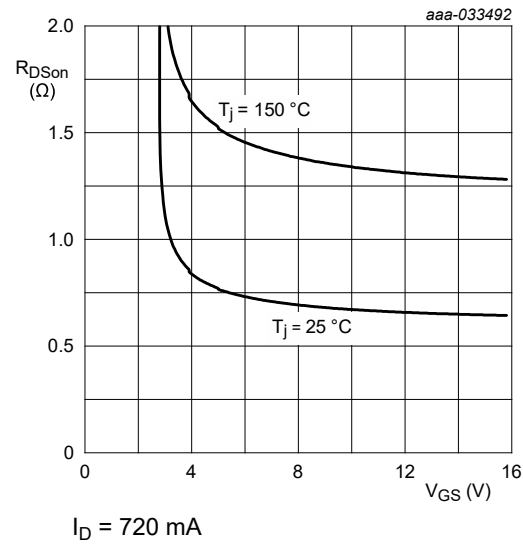


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

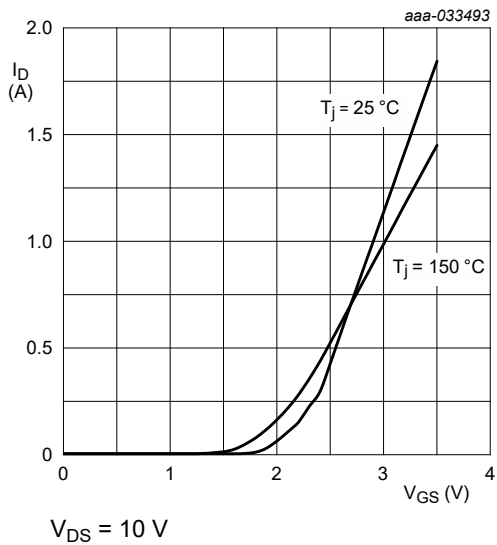


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

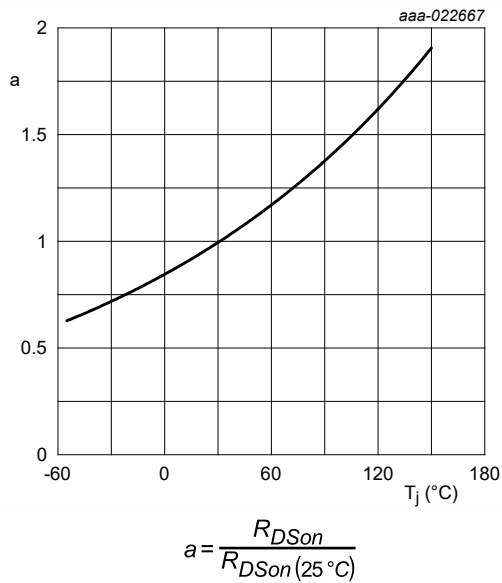


Fig. 11. Normalized drain-source on-state resistance as a function of ambient temperature; typical values

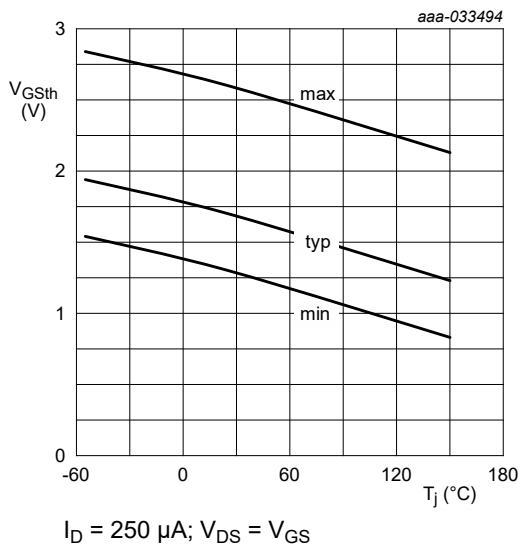


Fig. 12. Gate-source threshold voltage as a function of junction temperature

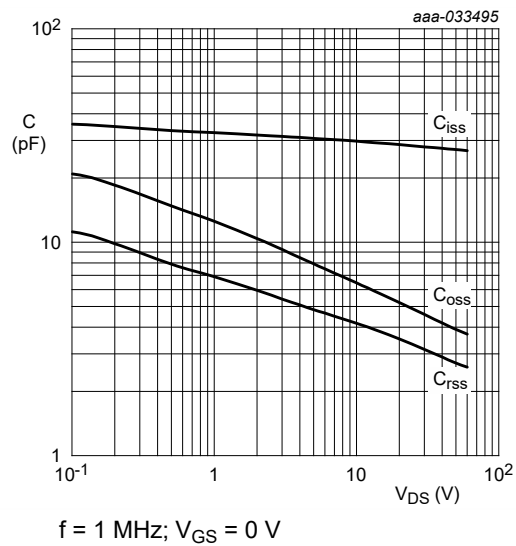


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

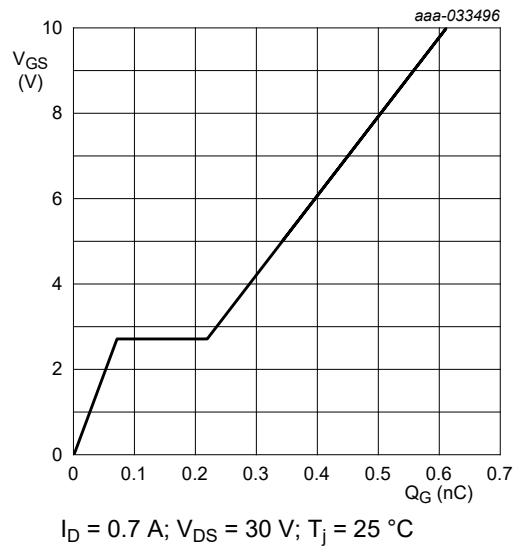


Fig. 14. Gate-source voltage as a function of gate charge; typical values

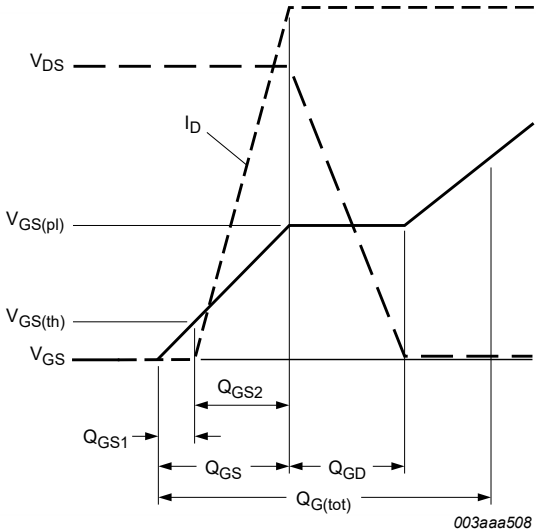


Fig. 15. Gate charge waveform definitions

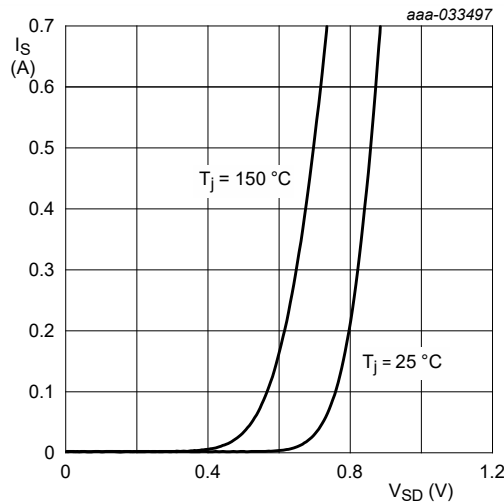


Fig. 16. Source current as a function of source-drain voltage; typical values

11. Test information

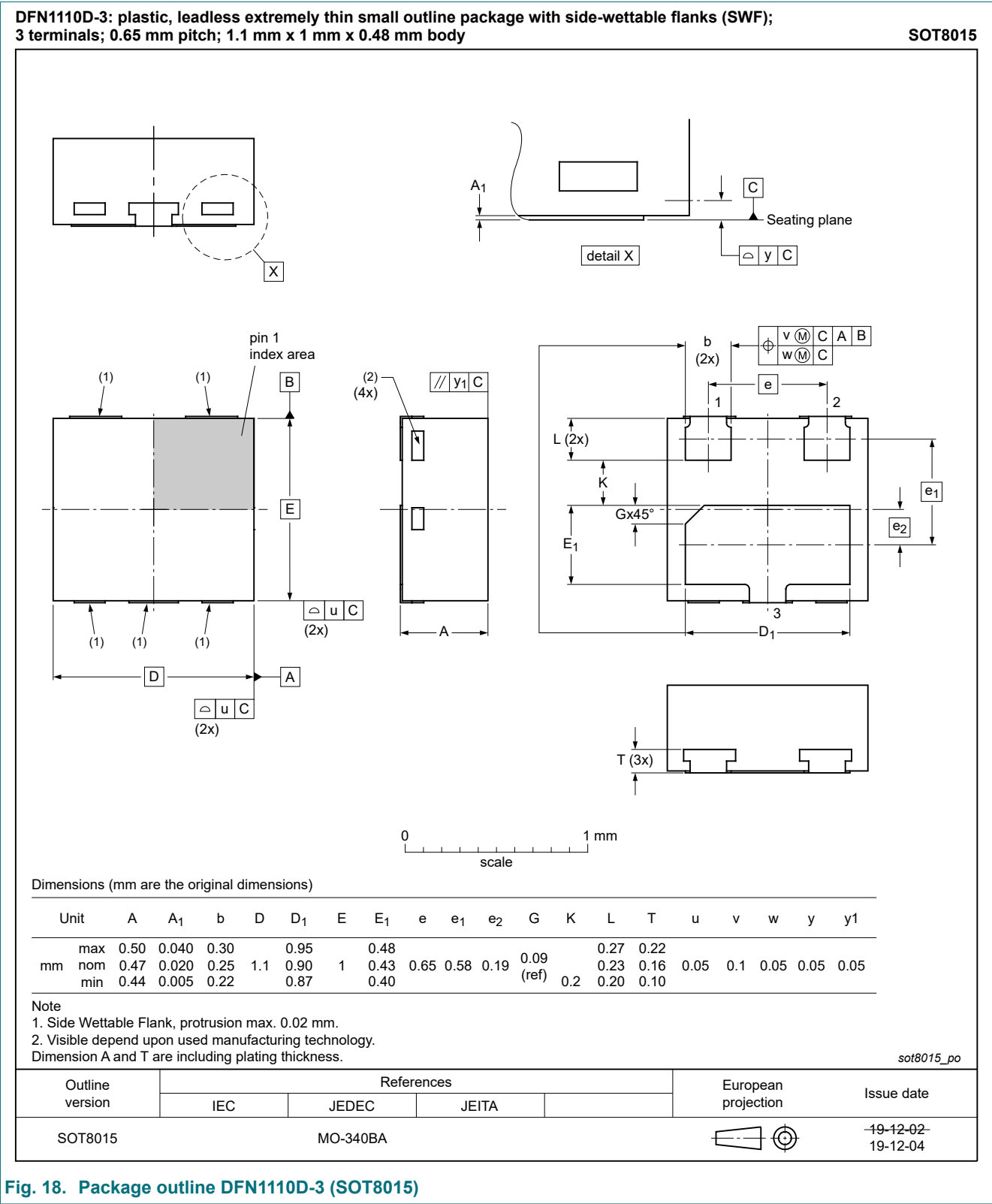


Fig. 17. Duty cycle definition

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



13. Soldering

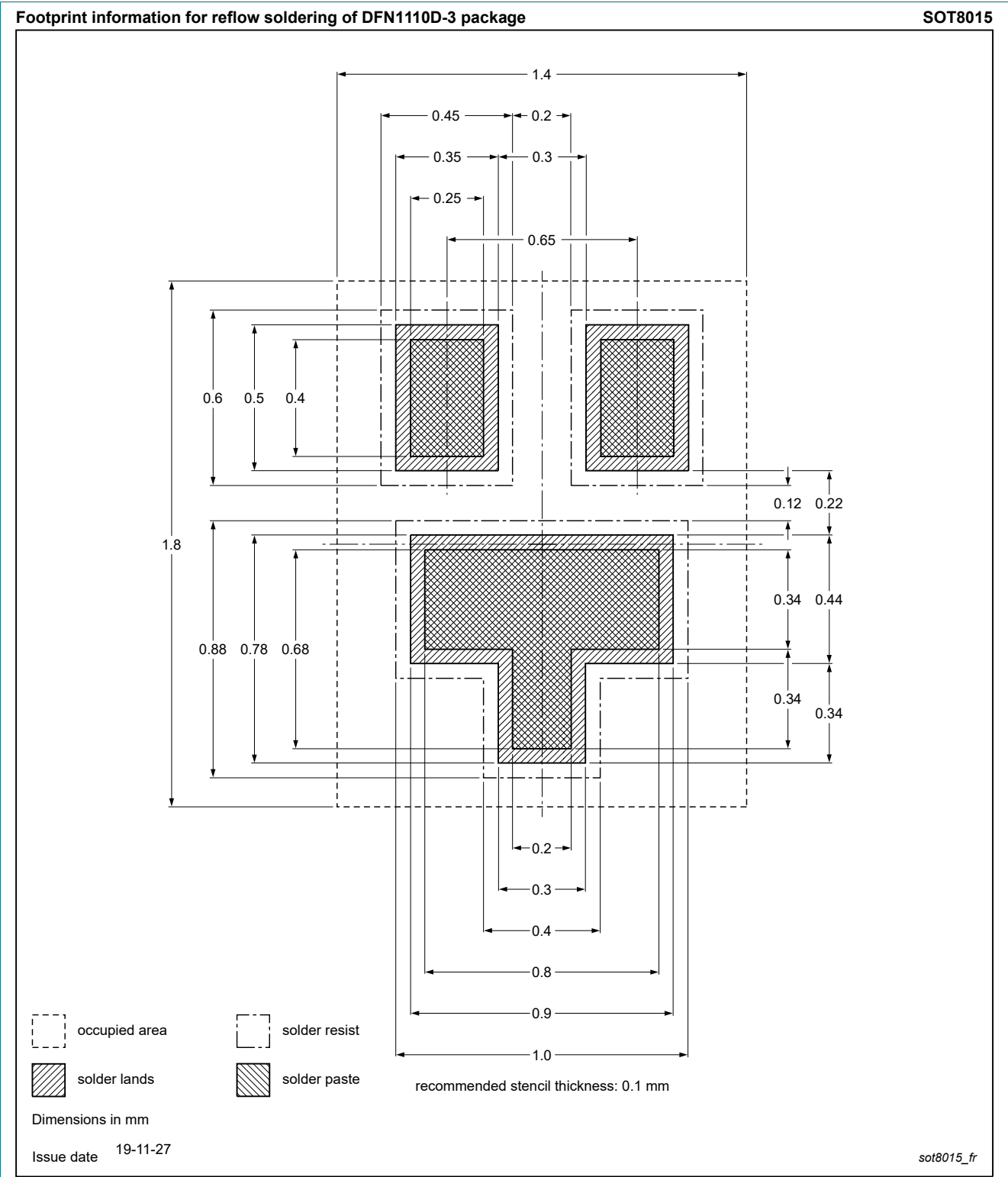


Fig. 19. Reflow soldering footprint for DFN1110D-3 (SOT8015)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
2N7002KQB v.1	20210922	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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