



NSF040120L3A0

1200 V, 40 mΩ, N-channel SiC MOSFET

6 December 2023

Product data sheet

1. General description

The NSF040120L3A0 is a Silicon Carbide based 1200 V power MOSFET in a well-established 3-pin TO-247-3 plastic package for through hole PCB mounting technology. The excellent R_{DSon} temperature stability combined with its fast switching speed makes it a product of choice in high power and high voltage industrial applications like E-vehicle charging infrastructure, photovoltaic inverters and motor drives.

2. Features and benefits

- Excellent R_{DSon} temperature stability
- Very low switching losses
- Fast reverse recovery
- Fast switching speed
- Temperature independent turn-off switching losses
- Very fast and robust intrinsic body diode

3. Applications

- E-vehicle charging infrastructure
- Photovoltaic inverters
- Switch mode power supply
- Uninterruptable power supply
- Motor drives

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage			-	-	1200	V
V_{GS}	gate-source voltage		[1]	-10	-	22	V
I_D	drain current	$T_c = 25\text{ °C}$	[2]	-	-	65	A
		$T_c = 100\text{ °C}$	[2]	-	-	46	A
I_{DM}	peak drain current	pulsed; t_p limited by T_j (max)	[3]	-	-	160	A
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 15\text{ V}$; $I_D = 40\text{ A}$; $T_j = 25\text{ °C}$		-	40	60	mΩ

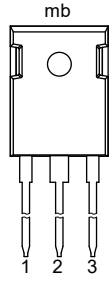
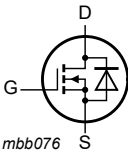
[1] Recommended turn off gate voltage is -5 V. Recommended turn on gate voltage is 15 V. Do not use with $V_{GSon} < 13\text{ V}$.

[2] Limited by $T_{j(max)}$ and $R_{th(j-c)max}$.

[3] Designed value (not tested).

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 TO-247-3L (SOT429-2)	
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NSF040120L3A0	TO-247-3L	Plastic single-ended through-hole package; heatsink mounted; 1 mounting hole; 3-lead TO-247-3L	SOT429-2

7. Marking

Table 4. Marking codes

Type number	Marking code
NSF040120L3A0	NSF0412A0

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			-	1200	V
V _{GS}	gate-source voltage		[1]	-10	22	V
I _D	drain current	T _c = 25 °C	[2]	-	65	A
		T _c = 100 °C	[2]	-	46	A
I _{DM}	peak drain current	pulsed; t _p limited by T _j (max)	[3]	-	160	A
P _{tot}	total power dissipation	T _c = 25 °C	[2]	-	313	W
T _j	junction temperature			-55	175	°C
T _{stg}	storage temperature			-55	150	°C
T _{sld(M)}	peak soldering temperature			-	260	°C
Source-drain diode						
I _S	source current	T _c = 25 °C	[2]	-	55	A
I _{SM}	peak source current	pulsed; limited by T _j (max)	[3]	-	120	A

[1] Recommended turn off gate voltage is -5 V. Recommended turn on gate voltage is 15 V. Do not use with V_{GSon} < 13 V.
[2] Limited by T_{j(max)} and R_{th(j-c)max}.
[3] Designed value (not tested).

9. Thermal characteristics

Table 6. Thermal characteristics

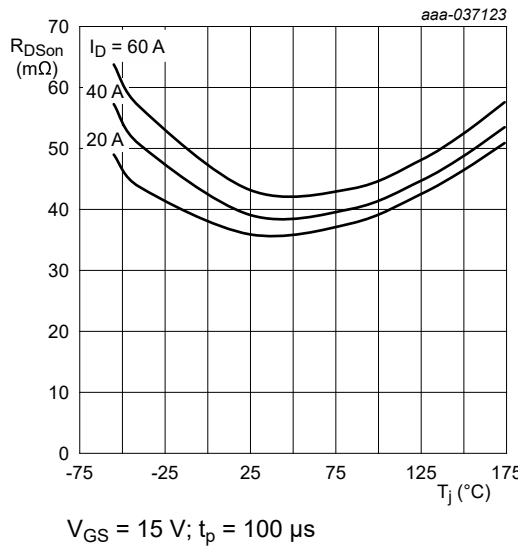
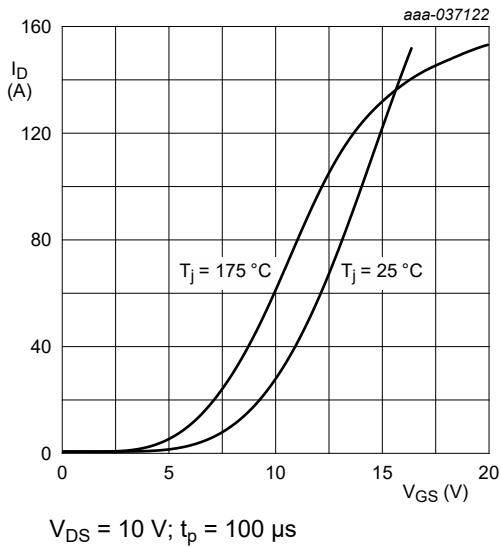
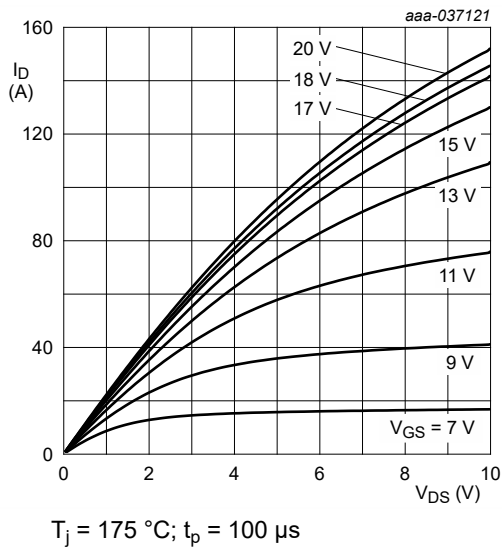
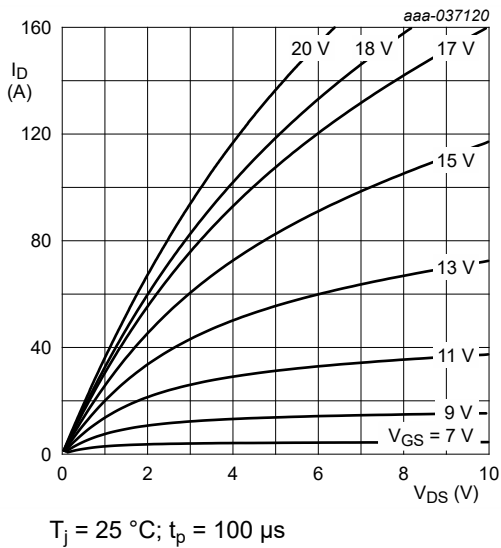
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R _{th(j-c)}	thermal resistance from junction to case			-	0.4	0.48	K/W

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
V _{(BR)DSS}	drain-source breakdown voltage	I _D = 10 μA; V _{GS} = 0 V; T _j = 25 °C		1200	-	-	V
V _{GS(th)}	gate-source threshold voltage	I _D = 4 mA; V _{DS} = V _{GS} ; T _j = 25 °C	[1]	1.7	2.3	2.9	V
I _{DSS}	drain leakage current	V _{DS} = 1200 V; V _{GS} = 0 V; T _j = 25 °C		-	-	100	μA
I _{GSS}	gate leakage current	V _{GS} = 22 V; V _{DS} = 0 V; T _j = 25 °C		-	-	100	nA
		V _{GS} = -10 V; V _{DS} = 0 V; T _j = 25 °C		-	-	100	nA
R _{DSon}	drain-source on-state resistance	V _{GS} = 15 V; I _D = 40 A; T _j = 25 °C		-	40	60	mΩ
		V _{GS} = 15 V; I _D = 40 A; T _j = 125 °C		-	45	-	mΩ
		V _{GS} = 15 V; I _D = 40 A; T _j = 175 °C		-	53	-	mΩ
		V _{GS} = 18 V; I _D = 40 A; T _j = 25 °C		-	31	-	mΩ
		V _{GS} = 18 V; I _D = 40 A; T _j = 175 °C		-	49	-	mΩ
g _{fs}	forward transconductance	V _{DS} = 10 V; I _D = 40 A; T _j = 25 °C		-	19	-	S
R _{G(int)}	internal gate resistance	f = 0.5 MHz; T _j = 25 °C		-	2.3	-	Ω
Dynamic characteristics							
Q _{G(tot)}	total gate charge	V _{DD} = 800 V; I _D = 40 A; V _{GS} = -5/+15 V; T _j = 25 °C		-	95	-	nC
Q _{GS}	gate-source charge			-	40	-	nC
Q _{GD}	gate-drain charge			-	30	-	nC
C _{iss}	input capacitance	V _{DD} = 800 V; f = 0.5 MHz; V _{GS} = 0 V; T _j = 25 °C		-	2600	-	pF
C _{oss}	output capacitance			-	136	-	pF
C _{rss}	reverse transfer capacitance			-	6	-	pF
t _{d(on)}	turn-on delay time	V _{DD} = 800 V; I _D = 40 A; R _{G(ext)} = 2.2 Ω; V _{GS} = -5/+15 V; L = 82 μH; T _j = 25 °C		-	57	-	ns
t _r	rise time			-	20	-	ns
t _{d(off)}	turn-off delay time			-	22	-	ns
t _f	fall time			-	9	-	ns
E _{on}	turn-on switching loss			-	1413	-	μJ
E _{off}	turn-off switching loss			-	160	-	μJ
Source-drain diode							
V _{SD}	source-drain voltage	I _S = 40 A; V _{GS} = -5 V; T _j = 25 °C		-	4.4	-	V
t _{rr}	reverse recovery time	V _{DD} = 800 V; I _S = 40 A; dI _S /dt = 1649 A/μs; T _j = 25 °C		-	31	-	ns
Q _r	recovered charge			-	217	-	nC

[1] Measured according to JEP183.



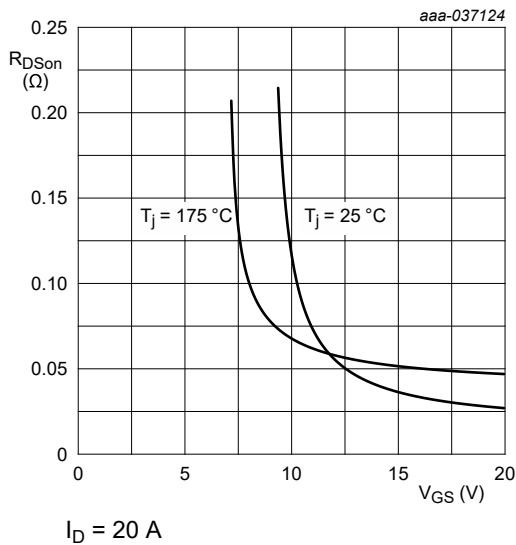


Fig. 5. Drain-source on-state resistance as a function of threshold voltage

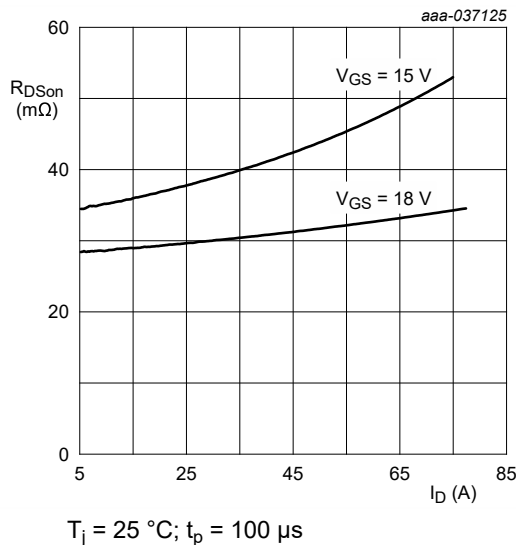


Fig. 6. Drain-source on-state resistance as a function of drain current; typical values

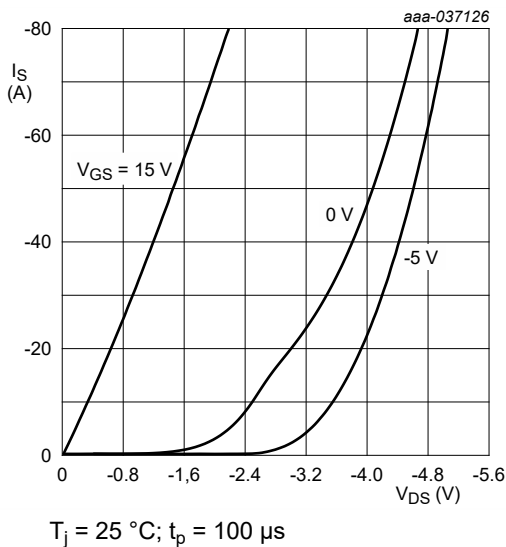


Fig. 7. Source current as a function of source-drain voltage; typical values (third quadrant characteristics)

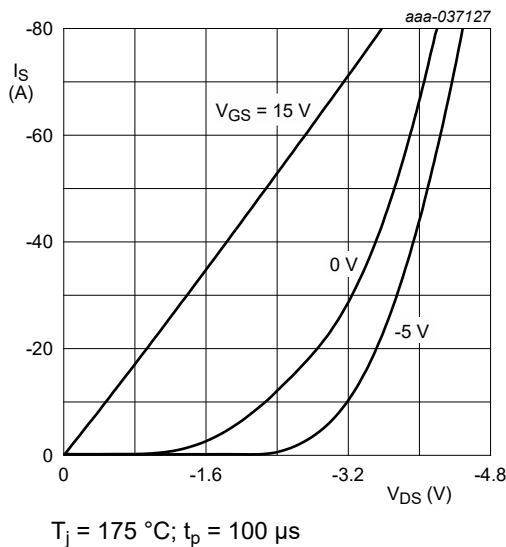


Fig. 8. Source current as a function of source-drain voltage; typical values (third quadrant characteristics)

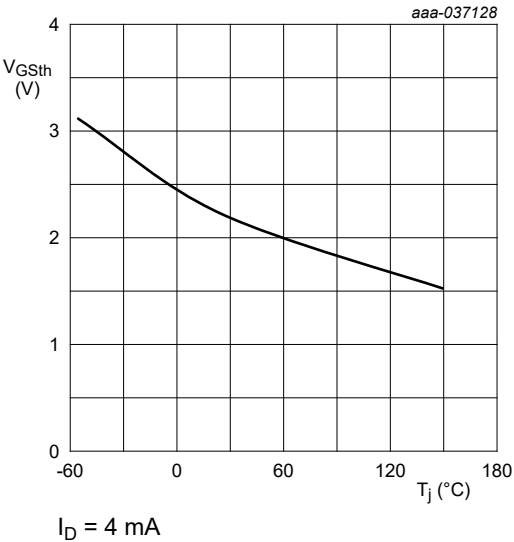


Fig. 9. Gate-source threshold voltage as a function of junction temperature; typical values

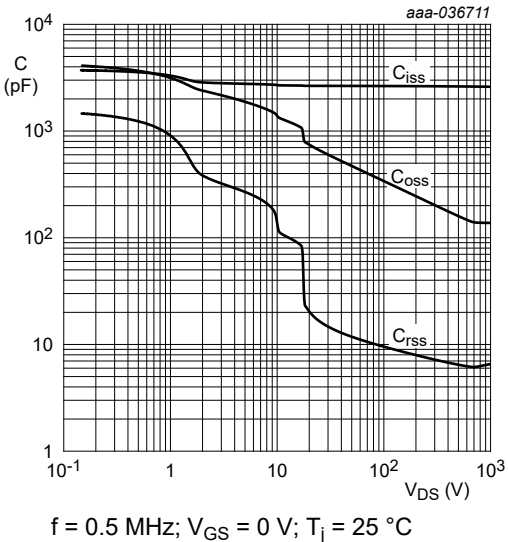


Fig. 10. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

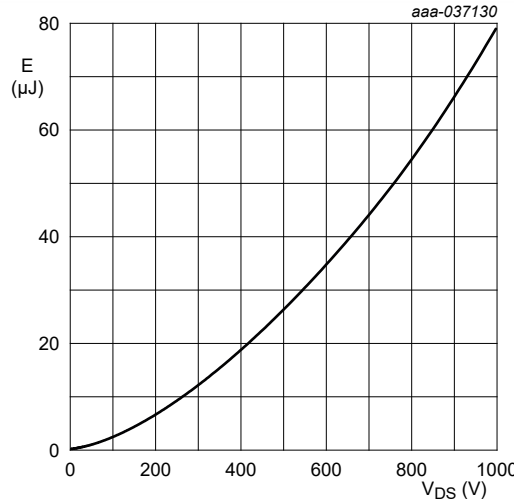


Fig. 11. C_{oss} stored energy as a function of drain-source voltage; typical values

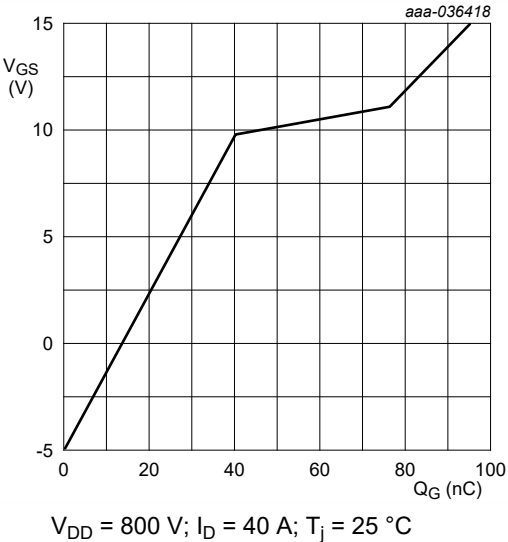


Fig. 12. Gate-source voltage as a function of gate charge; typical values

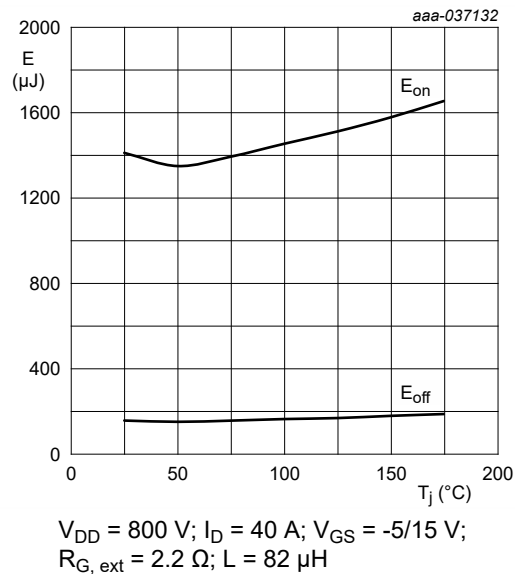


Fig. 13. Switching loss as a function of junction temperature; typical values

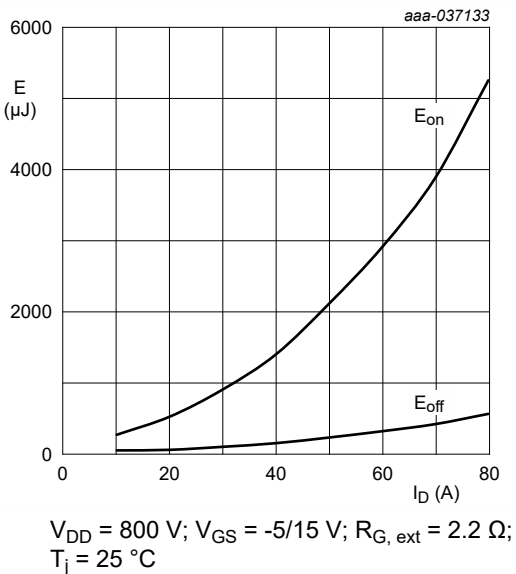


Fig. 14. Switching loss as a function of drain current; typical values

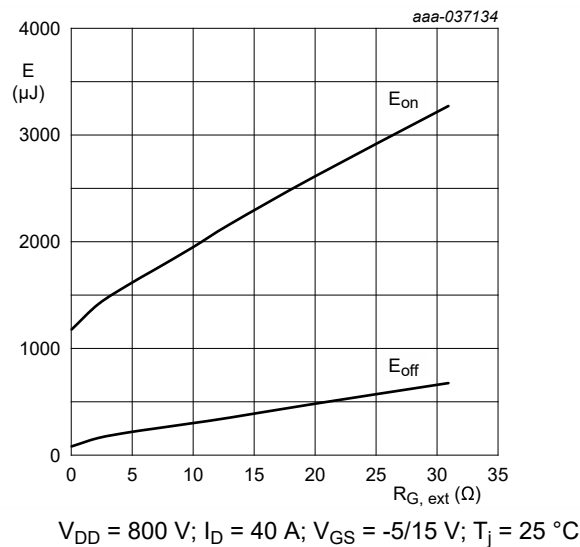


Fig. 15. Switching loss as a function of external gate resistance; typical values

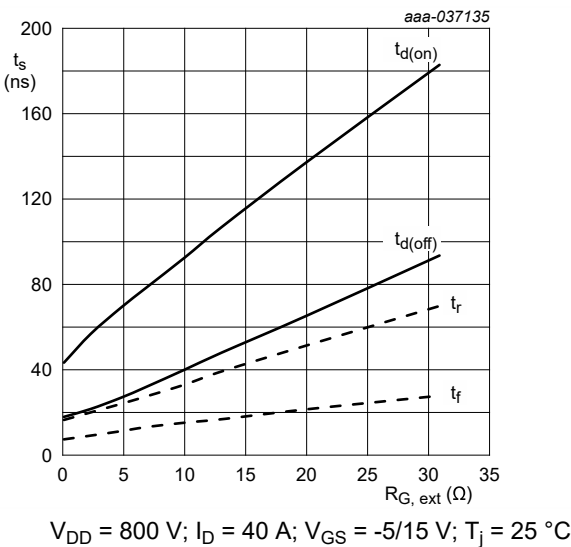


Fig. 16. Switching times as a function of external gate resistance; typical values

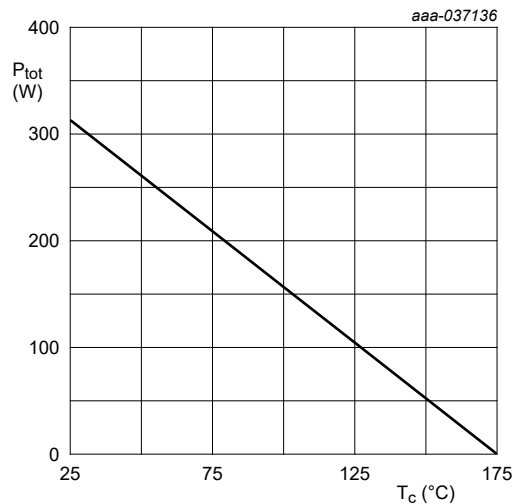


Fig. 17. Power dissipation derating as a function of case temperature; maximum values

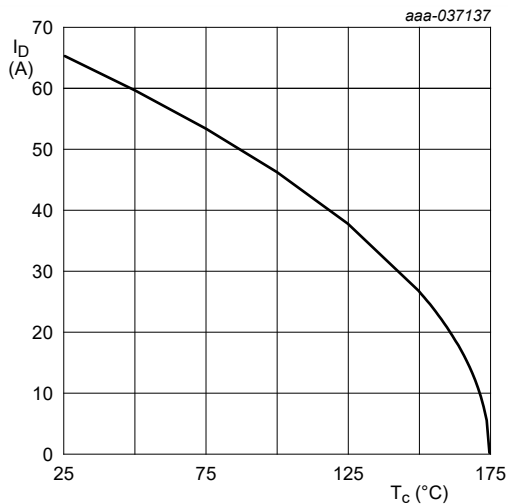


Fig. 18. Continuous drain current as a function of case temperature; maximum values

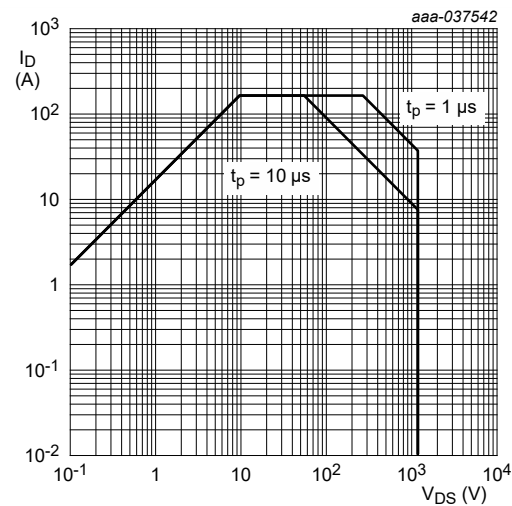


Fig. 19. Maximum safe operating area (SOA)

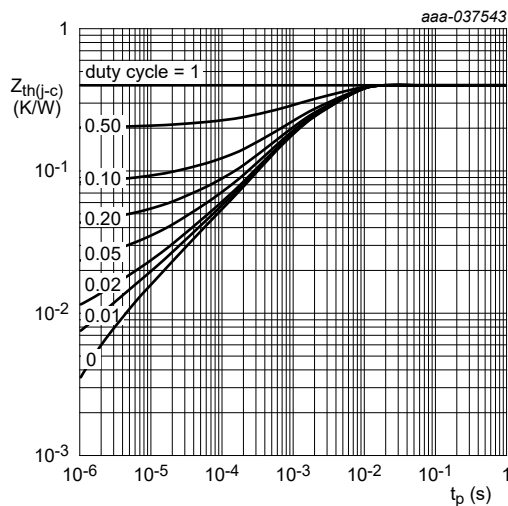


Fig. 20. Transient thermal impedance from junction to case as a function of pulse duration; typical values

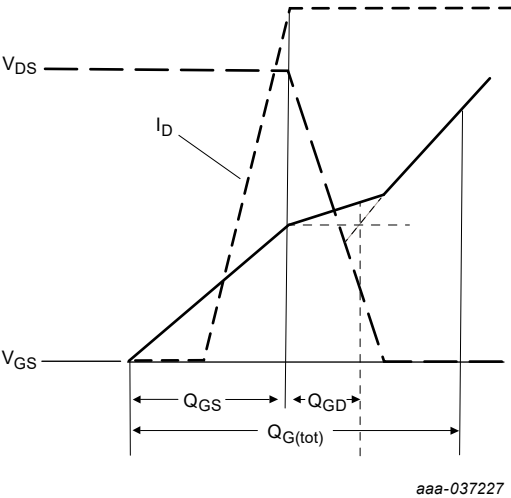


Fig. 21. Gate charge waveform definitions

11. Test information

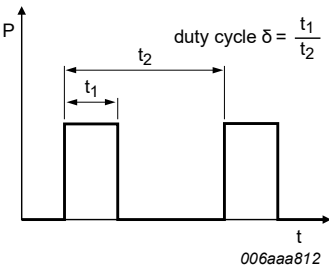


Fig. 22. Duty cycle definition

12. Package outline

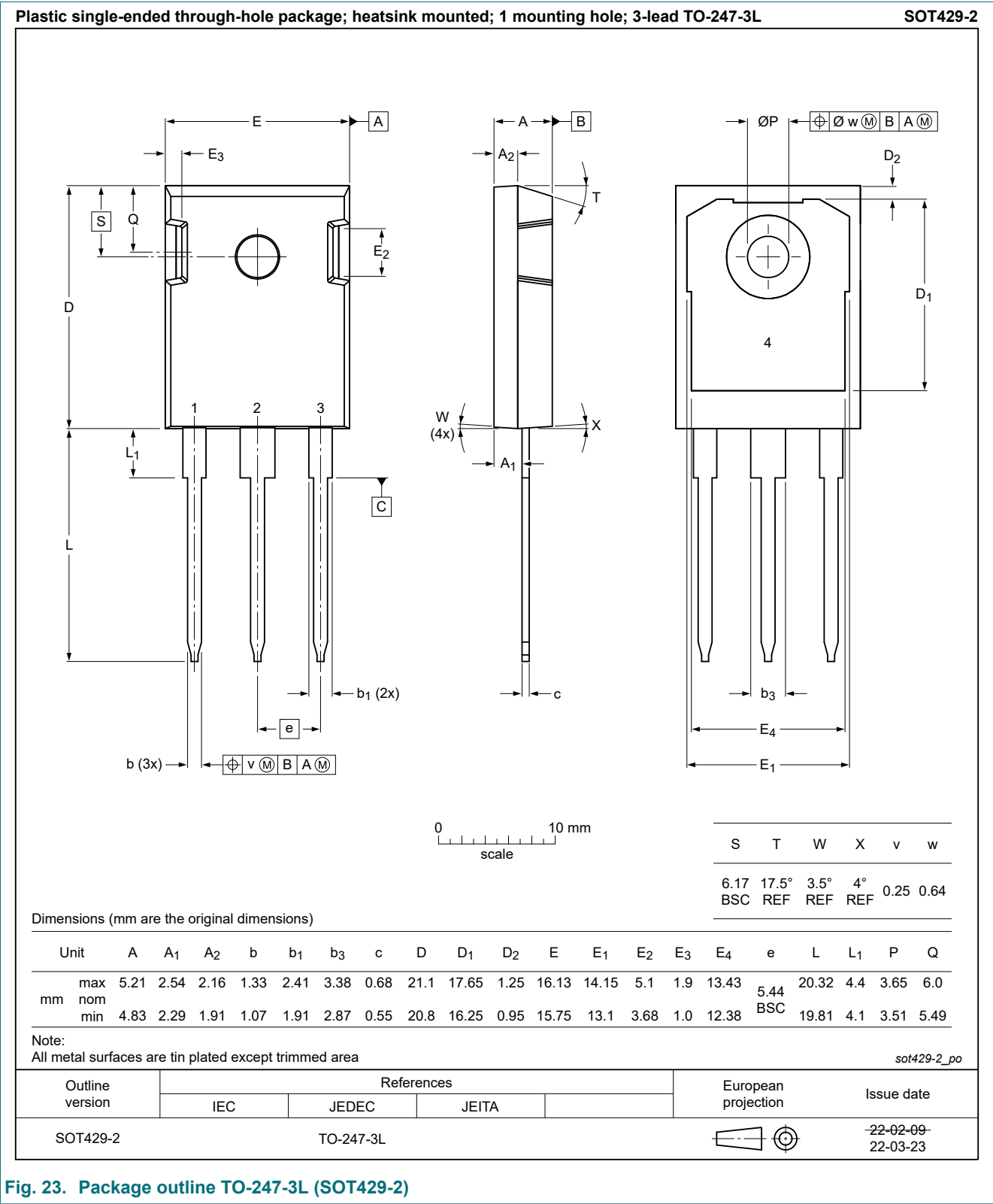


Fig. 23. Package outline TO-247-3L (SOT429-2)

13. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NSF040120L3A0 v.6	20231206	Product data sheet	-	NSF040120L3A0 v.5
Modifications:	• Characteristics: Title at figure 4 changed			
NSF040120L3A0 v.5	20231129	Product data sheet	-	NSF040120L3A0 v.4
NSF040120L3A0 v.4	20231020	Preliminary data sheet	-	NSF040120L3A0 v.3
NSF040120L3A0 v.3	20231006	Objective data sheet	-	NSF040120L3A0 v.2
NSF040120L3A0 v.2	20230905	Objective data sheet	-	NSF040120L3A0 v.1
NSF040120L3A0 v.1	202300502	Objective data sheet	-	-

14. 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.

- [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".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

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