

GANE3R9-150QBA

150 V, 3.9 mOhm Gallium Nitride (GaN) FET in a 4.0 mm x 6.0 mm Very-Thin-Profile Quad Flat No-Lead Package (VQFN)

30 April 2024

Product data sheet

1. General description

The GANE3R9-150QBA is a general purpose 150 V, 3.9 mΩ Gallium Nitride (GaN) FET in a Very-Thin-Profile Quad Flat No-Lead Package (VQFN) package. It is a normally-off e-mode device offering superior performance and very low on-state resistance.

2. Features and benefits

- Enhancement mode - normally-off power switch
- Ultra high frequency switching capability
- No body diode
- Low gate charge, low output charge
- Qualified for standard applications
- RoHS, Pb-free, REACH-compliant
- High efficiency and high power density
- Very-Thin-Profile Quad Flat No-Lead Package (VQFN) 4.0 mm x 6.0 mm

3. Applications

- High power density and high efficiency power conversion
- AC-to-DC converters, (secondary stage)
- High frequency DC-to-DC converters in 48 V systems
- Fast battery charging, mobile phone, laptop, tablet and USB type-C chargers
- Datacom and telecom (AC-to-DC and DC-to-DC) converters
- Motor drives
- LiDAR (non-automotive)
- Class D audio amplifiers

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$-40\text{ °C} \leq T_j \leq 150\text{ °C}$	-	-	150	V
I_D	drain current	$V_{GS} = 5\text{ V}; T_{mb} = 25\text{ °C}$	-	-	100	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ Fig. 1	-	-	65	W
T_j	junction temperature		-40	-	150	°C
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 5\text{ V}; I_D = 30\text{ A}; T_j = 25\text{ °C};$ Fig. 8; Fig. 9	-	3.2	3.9	mΩ
		$V_{GS} = 5\text{ V}; I_D = 30\text{ A}; T_j = 150\text{ °C};$ Fig. 8; Fig. 10	-	7	-	mΩ
R_G	gate resistance	$f = 5\text{ MHz}$	-	1.9	-	Ω

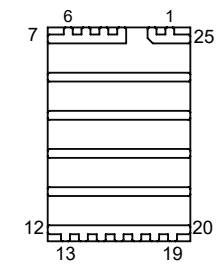
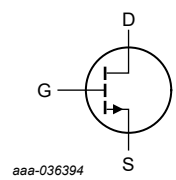
150 V, 3.9 mOhm Gallium Nitride (GaN) FET in a 4.0 mm x 6.0 mm Very-Thin-Profile Quad Flat No-Lead Package (VQFN)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 30\text{ A}$; $V_{DS} = 75\text{ V}$; $V_{GS} = 5\text{ V}$; $T_j = 25\text{ °C}$; Fig. 11 ; Fig. 12	-	3.5	-	nC
$Q_{G(tot)}$	total gate charge		-	20	-	nC
Q_{oss}	output charge	$V_{GS} = 0\text{ V}$; $V_{DS} = 75\text{ V}$; Fig. 15	[1]	130	-	nC

[1] Q_r is not specified separately from Q_{oss} for e-mode GaN FETs, since $Q_r = Q_{oss} + Q_D$, and $Q_D = 0$. (Q_D is charge associated with diffusion of minority carriers. Since there is no body diode, no minority carriers in excess of Q_{oss} have to be transferred for e-mode GaN FETs.)

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1,2,25	G	gate	 <p>Transparent top view VQFN7 (SOT8091-1)</p>	 <p>aaa-036394</p>
3-7,9,11,21,23	S	source		
8,10,12-20,22,24	D	drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
GANE3R9-150QBA	VQFN7	very thin quad flatpack; no leads	SOT8091-1

7. Marking

Table 4. Marking codes

Type number	Marking code
GANE3R9-150QBA	3R9EQBA

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	-40 °C ≤ T _J ≤ 150 °C	-	150	V
V _{GS}	gate-source voltage		-4	6	V
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 1	-	65	W
I _D	drain current	V _{GS} = 5 V; T _{mb} = 25 °C	-	100	A
I _{DM}	peak drain current	pulsed; t _p = 100 μs; T _{mb} = 25 °C; Fig. 2	-	260	A
T _{stg}	storage temperature		-40	150	°C
T _J	junction temperature		-40	150	°C
T _{sld(M)}	peak soldering temperature		-	260	°C

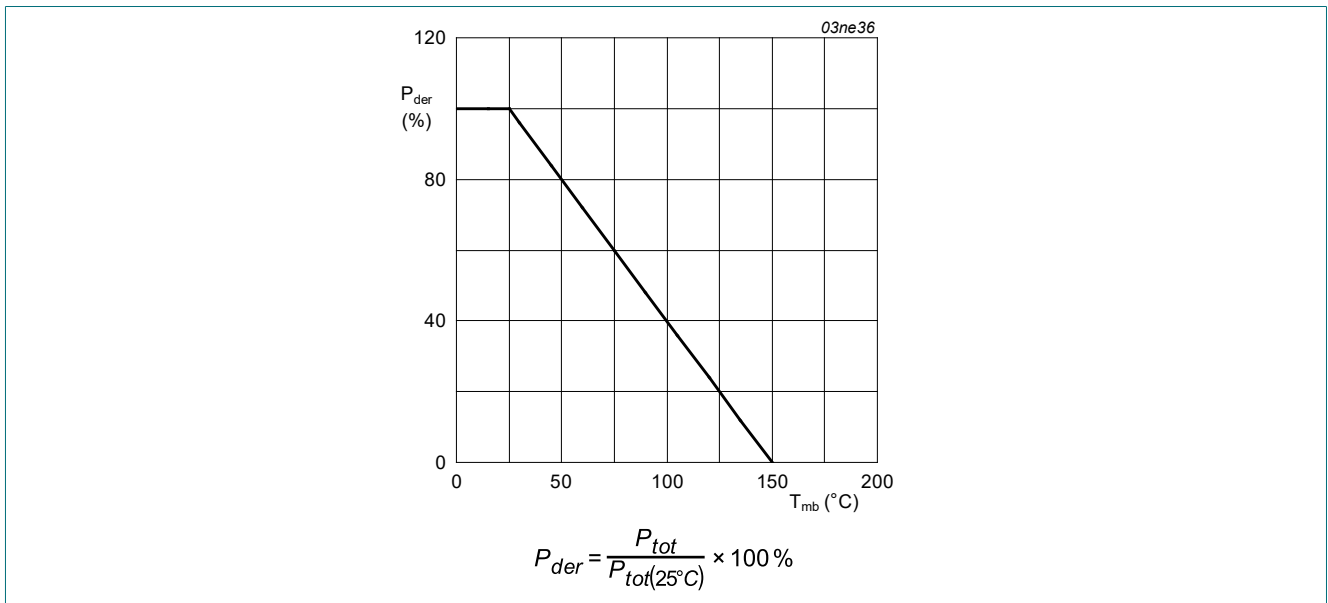
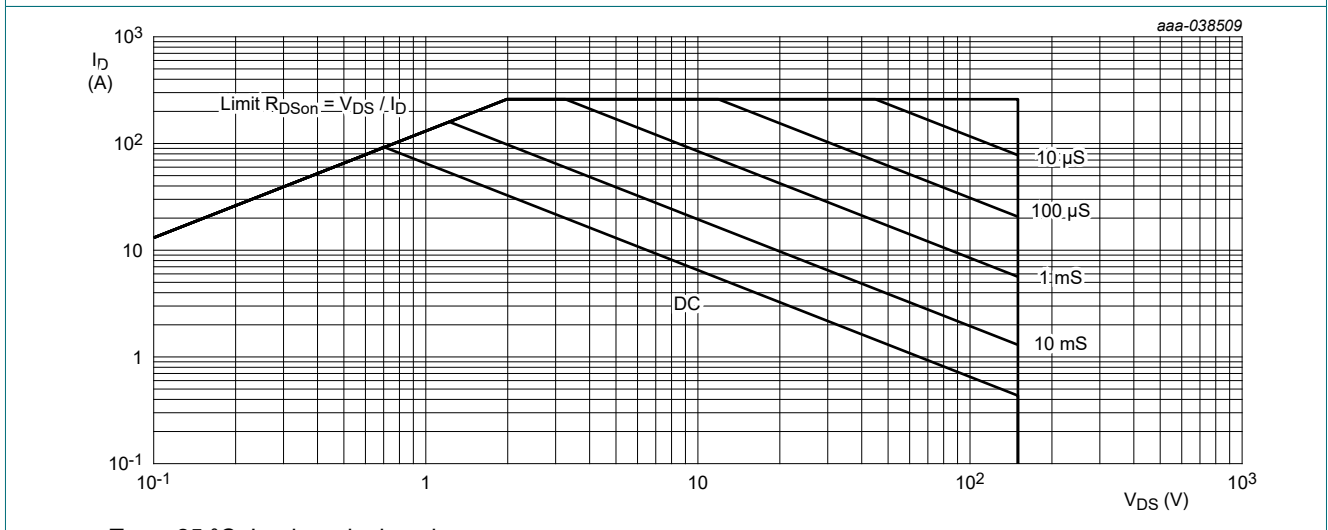


Fig. 1. Normalized total power dissipation as a function of mounting base temperature



T_{mb} = 25 °C; I_{DM} is a single pulse

Fig. 2. Safe operating area; 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
$R_{th(j-c)}$	thermal resistance from junction to case		-	13.96	-	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 3	-	1.92	-	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	[1]	-	57.56	-	K/W

[1] $R_{th(j-a)}$ is determined with the device mounted on one square inch of copper pad, single layer 2 oz copper on FR4 board.

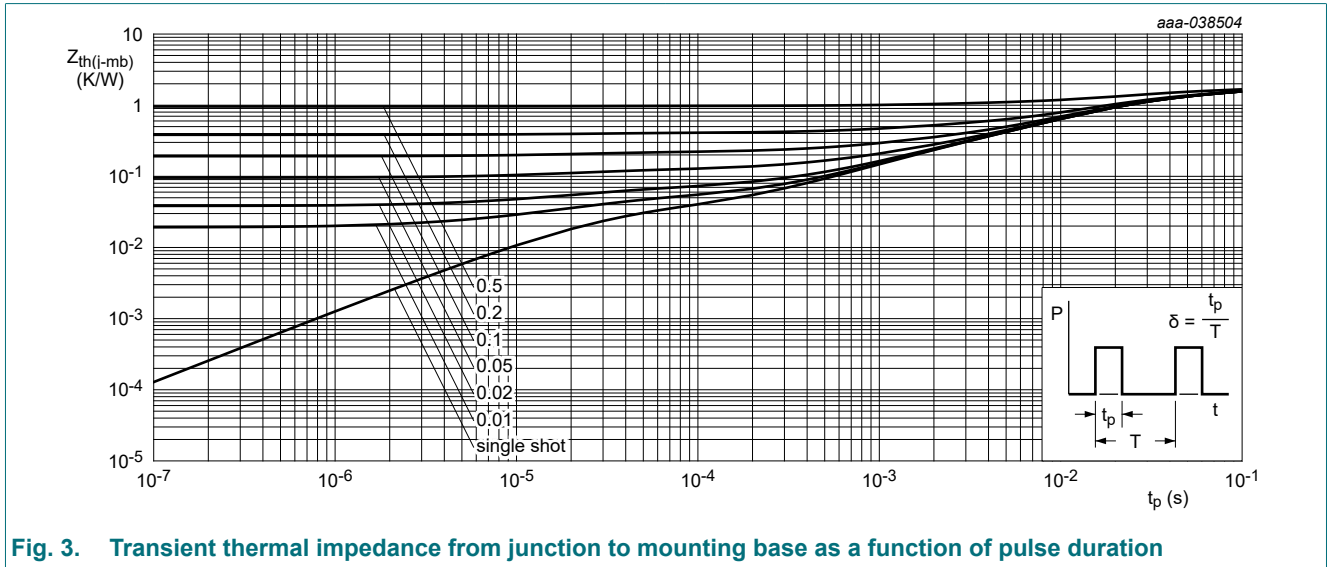


Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 12 \text{ mA}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 7	0.8	1.1	2.1	V
		$I_D = 12 \text{ mA}; V_{DS}=V_{GS}; T_j = 150 \text{ }^\circ\text{C};$ Fig. 7	-	1	-	V
I_{DSS}	drain leakage current	$V_{DS} = 150 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	150	μA
I_{GSS}	gate leakage current	$V_{GS} = 5 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	μA
		$V_{GS} = 6 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	6	1000	μA
		$V_{GS} = -4 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.1	100	μA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 5 \text{ V}; I_D = 30 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 8; Fig. 9	-	3.2	3.9	m Ω
		$V_{GS} = 5 \text{ V}; I_D = 30 \text{ A}; T_j = 150 \text{ }^\circ\text{C};$ Fig. 8; Fig. 10	-	7	-	m Ω
R_G	gate resistance	$f = 5 \text{ MHz}$	-	1.9	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 30 \text{ A}; V_{DS} = 75 \text{ V}; V_{GS} = 5 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ Fig. 11; Fig. 12	-	20	-	nC
Q_{GS}	gate-source charge		-	5	-	nC
Q_{GD}	gate-drain charge		-	3.5	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 30 \text{ A}; V_{DS} = 75 \text{ V}$	-	2	-	V
C_{iss}	input capacitance	$V_{DS} = 75 \text{ V}; V_{GS} = 0 \text{ V}; f = 100 \text{ kHz};$ $T_j = 25 \text{ }^\circ\text{C};$ Fig. 13	-	2200	-	pF
C_{oss}	output capacitance		-	900	-	pF
C_{rss}	reverse transfer capacitance		-	10.5	-	pF
$C_{o(er)}$	effective output capacitance, energy related	$V_{DS} = 75 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 14	-	1300	-	pF
$C_{o(tr)}$	effective output capacitance, time related	$V_{DS} = 75 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	1700	-	pF
Q_{oss}	output charge	$V_{GS} = 0 \text{ V}; V_{DS} = 75 \text{ V};$ Fig. 15	[1]	130	-	nC
Source-drain characteristics						
V_{SD}	source-drain voltage	$I_S = 0.5 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 16; Fig. 17; Fig. 18; Fig. 19	-	1.5	-	V

- [1] Q_r is not specified separately from Q_{oss} for e-mode GaN FETs, since $Q_r = Q_{oss} + Q_D$, and $Q_D = 0$. (Q_D is charge associated with diffusion of minority carriers. Since there is no body diode, no minority carriers in excess of Q_{oss} have to be transferred for e-mode GaN FETs.)

150 V, 3.9 mOhm Gallium Nitride (GaN) FET in a 4.0 mm x 6.0 mm Very-Thin-Profile Quad Flat No-Lead Package (VQFN)

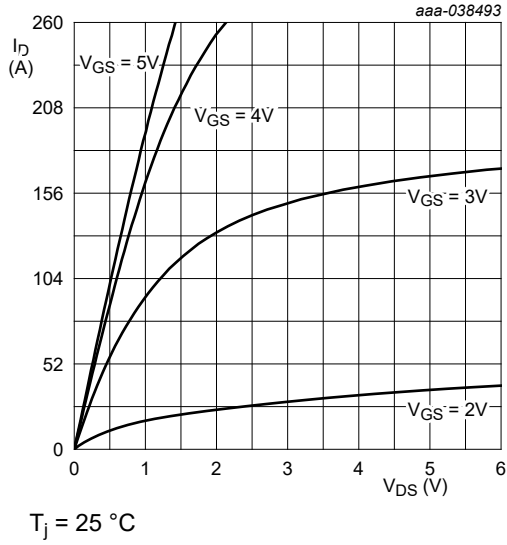


Fig. 4. Output characteristics: drain current as a function of drain-source voltage; typical values

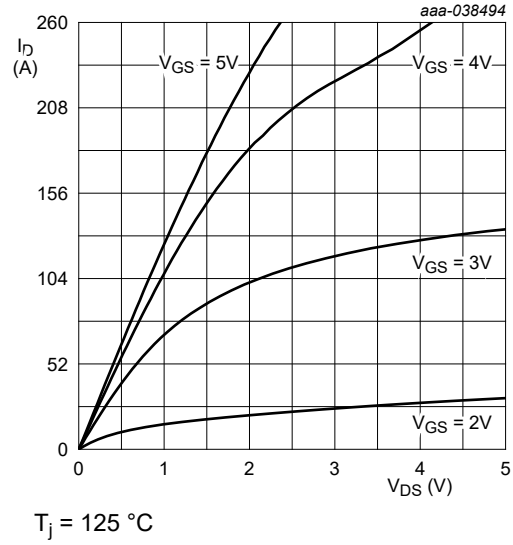


Fig. 5. Output characteristics: drain current as a function of drain-source voltage; typical values

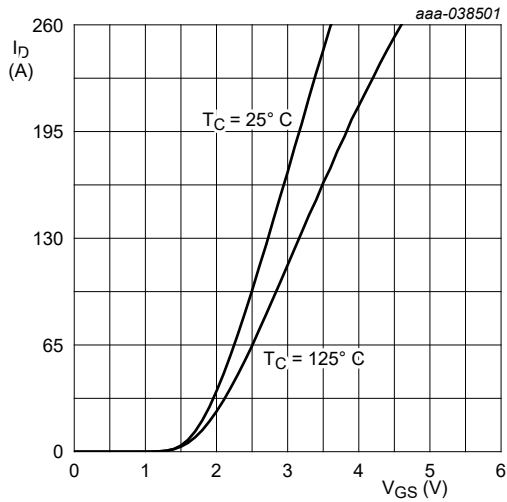


Fig. 6. Transfer characteristics; drain current as a function of gate-source voltage; typical values

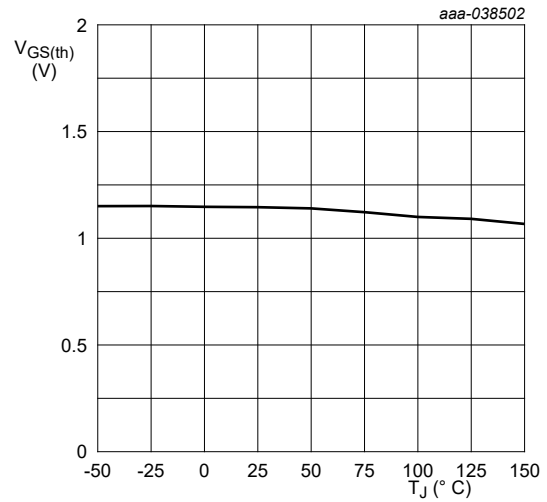


Fig. 7. Gate-source threshold voltage as a function of junction temperature

150 V, 3.9 mOhm Gallium Nitride (GaN) FET in a 4.0 mm x 6.0 mm Very-Thin-Profile Quad Flat No-Lead Package (VQFN)

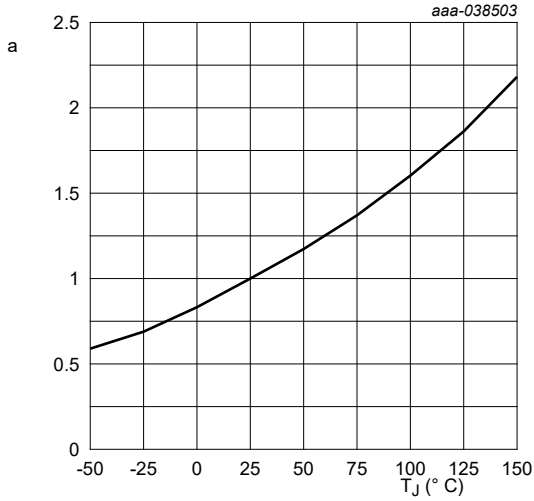


Fig. 8. Normalized drain-source on-state resistance factor as a function of junction temperature

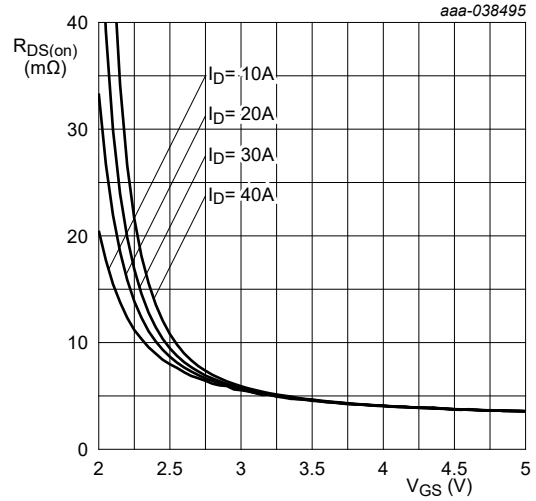


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

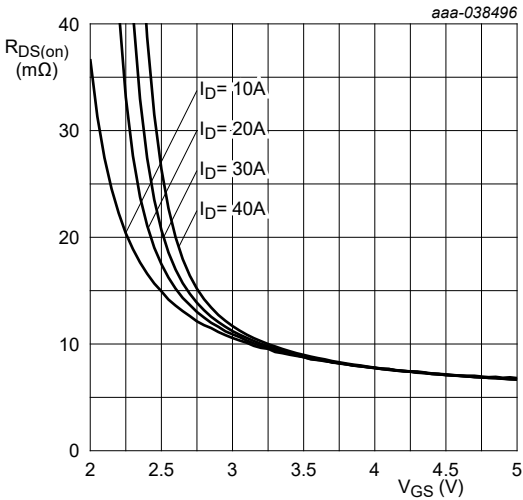


Fig. 10. Drain-source on-state resistance as a function of gate-source voltage; typical values

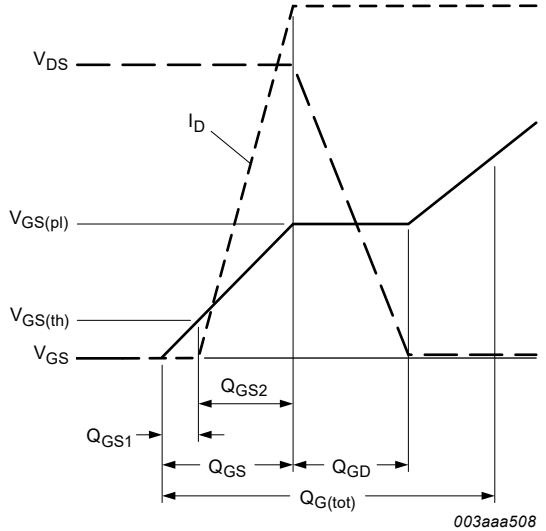
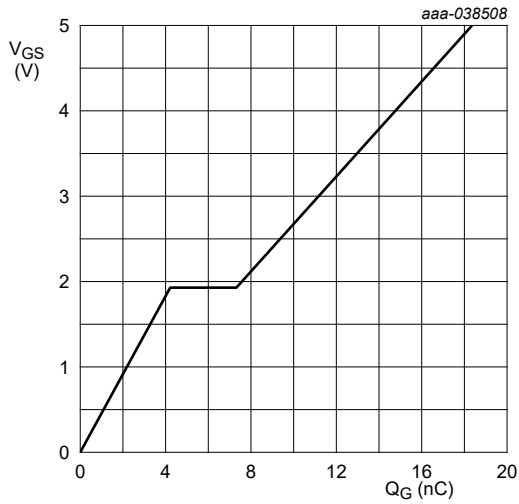


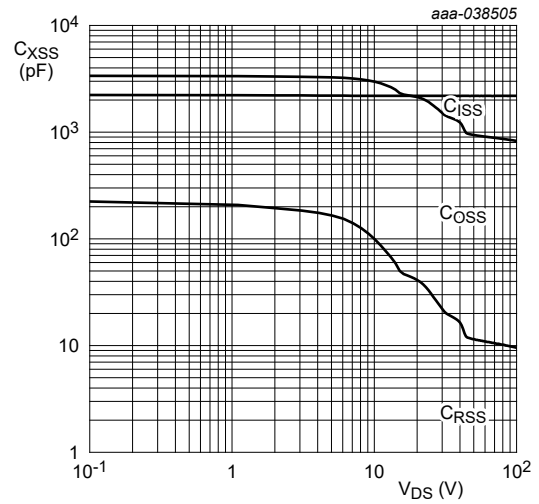
Fig. 11. Gate charge waveform definitions

150 V, 3.9 mOhm Gallium Nitride (GaN) FET in a 4.0 mm x 6.0 mm Very-Thin-Profile Quad Flat No-Lead Package (VQFN)



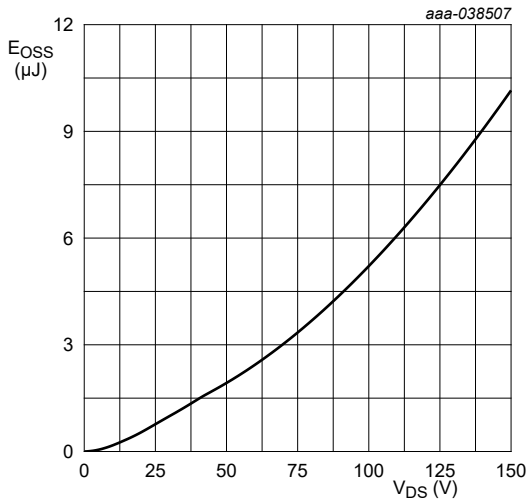
$T_J = 25\text{ }^\circ\text{C}$; $I_D = 30\text{ A}$

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



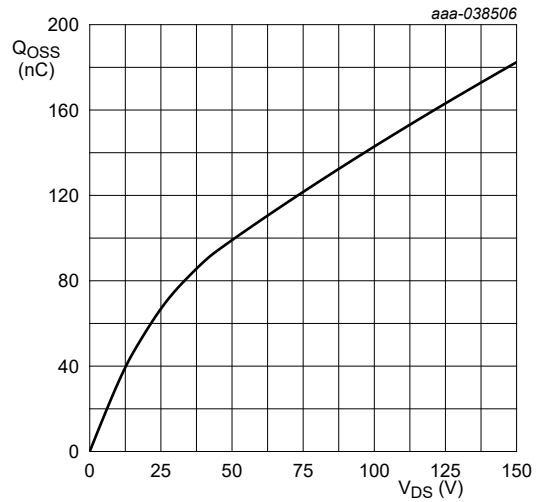
$V_{GS} = 0\text{ V}$; $f = 100\text{ kHz}$

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



Freq. = 100 kHz

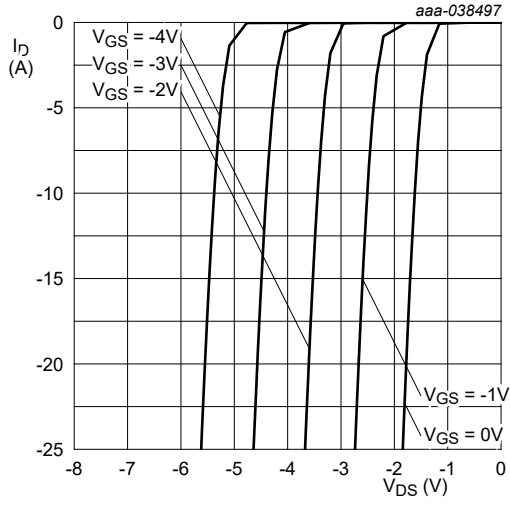
Fig. 14. COSS stored energy as a function of drain-source voltage; typical values



Freq. = 100 kHz

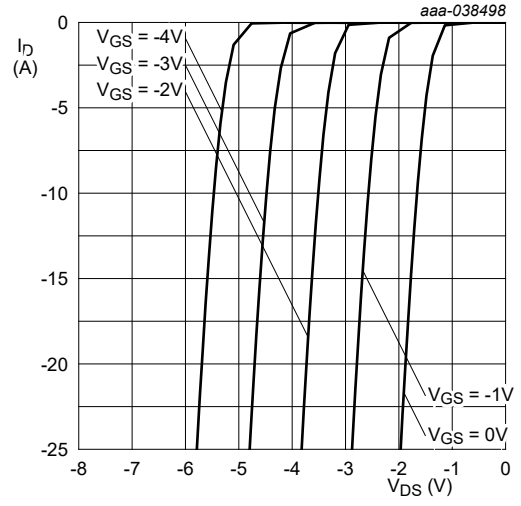
Fig. 15. Output charge as a function of drain-source voltage; typical values

150 V, 3.9 mOhm Gallium Nitride (GaN) FET in a 4.0 mm x 6.0 mm Very-Thin-Profile Quad Flat No-Lead Package (VQFN)



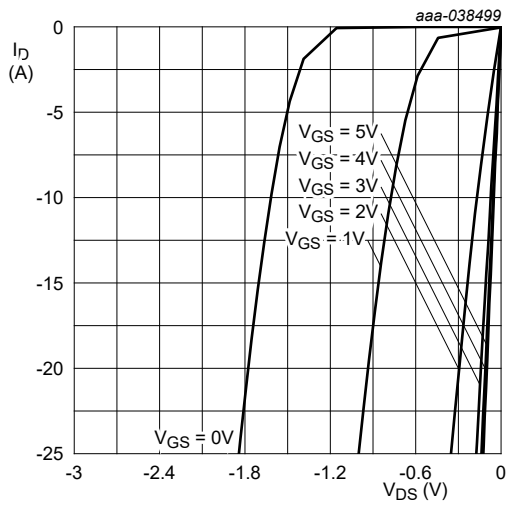
$T_j = 25\text{ }^\circ\text{C}$

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



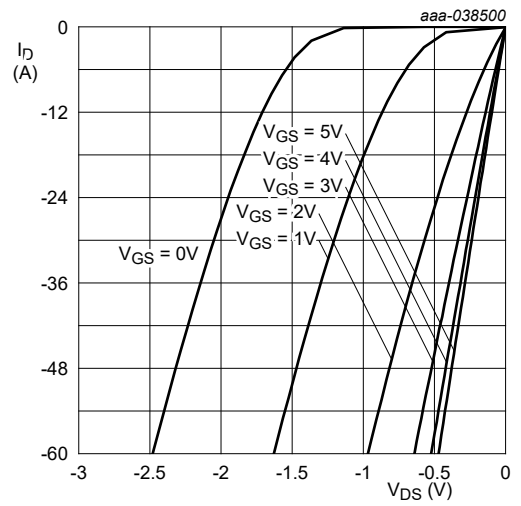
$T_j = 125\text{ }^\circ\text{C}$

Fig. 17. Source current as a function of source-drain voltage; typical values



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

Fig. 18. Source current as a function of source-drain voltage; typical values



$T_j = 125\text{ }^\circ\text{C}$

Fig. 19. Source current as a function of source-drain voltage; typical values

11. Package outline

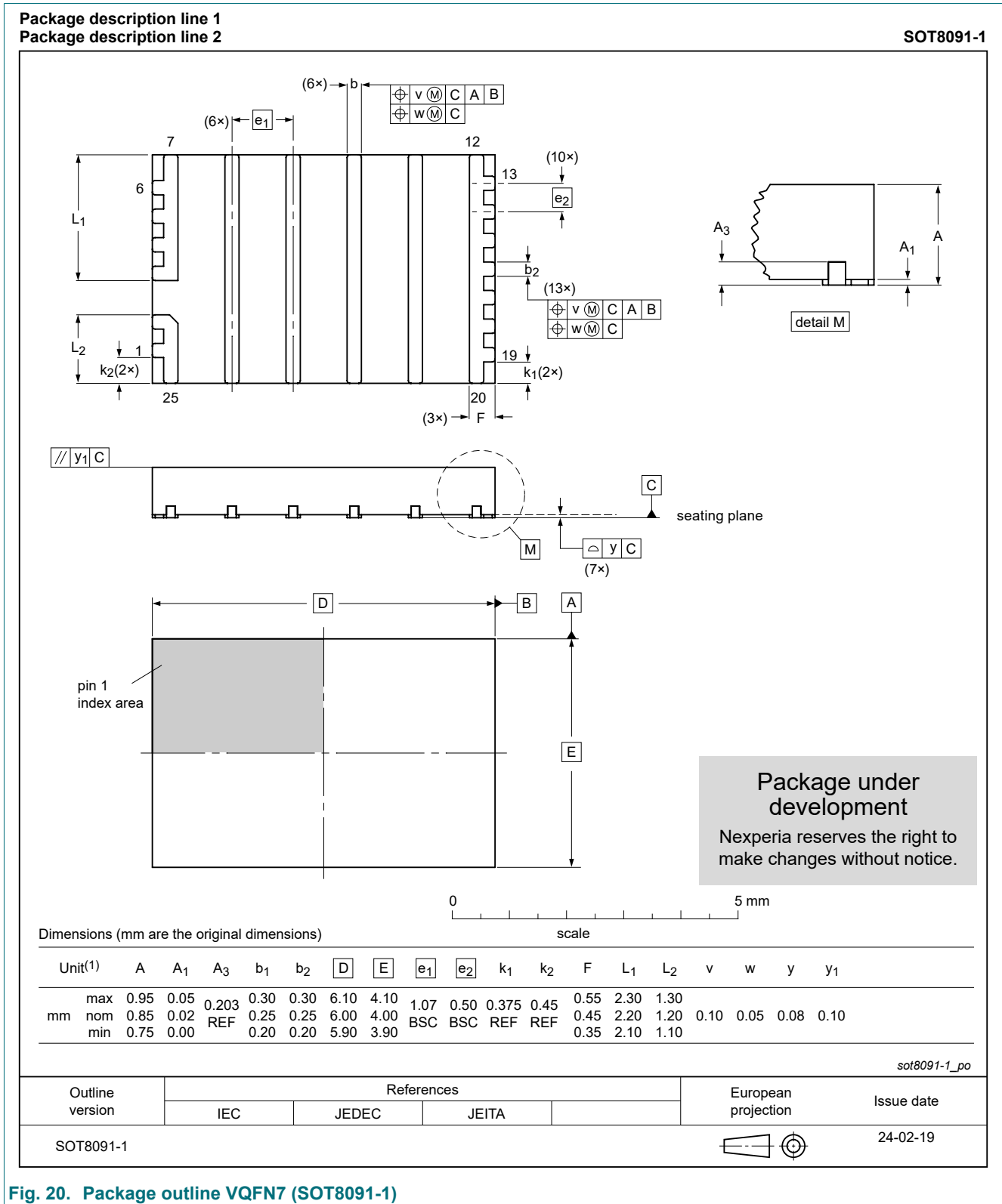


Fig. 20. Package outline VQFN7 (SOT8091-1)

12. Soldering

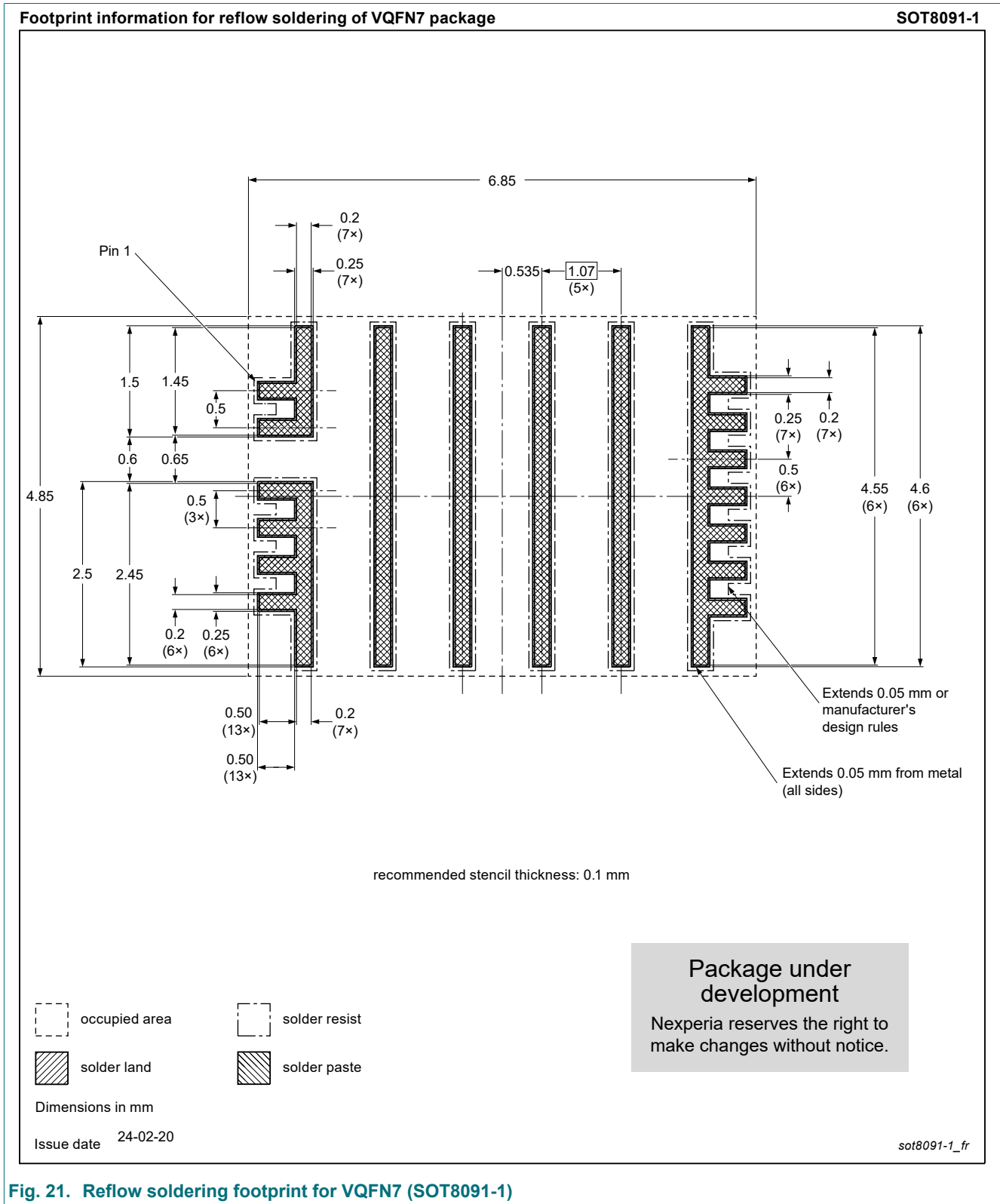


Fig. 21. Reflow soldering footprint for VQFN7 (SOT8091-1)

150 V, 3.9 mOhm Gallium Nitride (GaN) FET in a 4.0 mm x 6.0 mm Very-Thin-Profile Quad Flat No-Lead Package (VQFN)

13. 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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