



# THE DATASHEET OF GAN080-650EBEZ





# GAN080-650EBE

650 V, 80 mOhm Gallium Nitride (GaN) FET in a DFN  
8 mm x 8 mm package

5 May 2023

Product data sheet

## 1. General description

The GAN080-650EBE is a general purpose 650 V, 80 mΩ Gallium Nitride (GaN) FET in a DFN 8 mm x 8 mm surface mount package. It is a normally-off e-mode device offering superior performance.

## 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
- ESD protection
- RoHS, Pb-free, REACH-compliant
- High efficiency and high power density
- Low package inductance and low package resistance

## 3. Applications

- High power density and high efficiency power conversion
- AC-to-DC converters, totem pole PFC
- DC-to-DC converters
- 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
- Solar (PV) inverters
- Class D audio amplifiers, TV PSU and LED drivers

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$-55\text{ °C} \leq T_j \leq 150\text{ °C}$	-	-	650	V
$V_{TDS}$	transient drain to source voltage	pulsed; $t_p = 1\text{ }\mu\text{s}$ ; $\delta_{factor} = 0.01$	-	-	800	V
$I_D$	drain current	$V_{GS} = 6\text{ V}$ ; $T_{mb} = 25\text{ °C}$	[1]	-	29	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>	-	-	240	W
$T_j$	junction temperature		-55	-	150	°C
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 6\text{ V}$ ; $I_D = 8\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 11</a> ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	60	80	mΩ
		$V_{GS} = 6\text{ V}$ ; $I_D = 8\text{ A}$ ; $T_j = 150\text{ °C}$ ; <a href="#">Fig. 11</a> ; <a href="#">Fig. 14</a>	-	135	-	mΩ

650 V, 80 mOhm Gallium Nitride (GaN) FET in a DFN 8 mm x 8 mm package

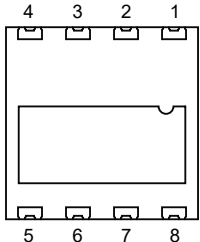
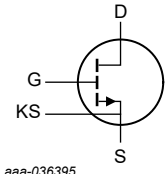
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_G$	gate resistance	$f = 5 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; open drain	-	3	-	$\Omega$
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$I_D = 8 \text{ A}$ ; $V_{DS} = 400 \text{ V}$ ; $V_{GS} = 6 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 15</a> ; <a href="#">Fig. 16</a>	-	2.2	-	nC
$Q_{G(\text{tot})}$	total gate charge		-	6.2	-	nC
$Q_{oss}$	output charge	$V_{GS} = 0 \text{ V}$ ; $V_{DS} = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	[2]	60	-	nC

[1] Limited by device saturation

[2]  $Q_r$  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	D	drain	 <p>Transparent top view <b>DFN8080-8 (SOT8074-1)</b></p>	 <p>aaa-036395</p>
2	D	drain		
3	D	drain		
4	D	drain		
5	S	source		
6	S	source		
7	KS	kelvin source		
8	G	gate		
mb	S	mounting base; connected to source		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
GAN080-650EBE	DFN8080-8	plastic thermal enhanced small outline package; no leads; 8 terminals; body: 8 x 8 x 0.9 mm	SOT8074-1

## 7. Marking

Table 4. Marking codes

Type number	Marking code
GAN080-650EBE	080IEBE

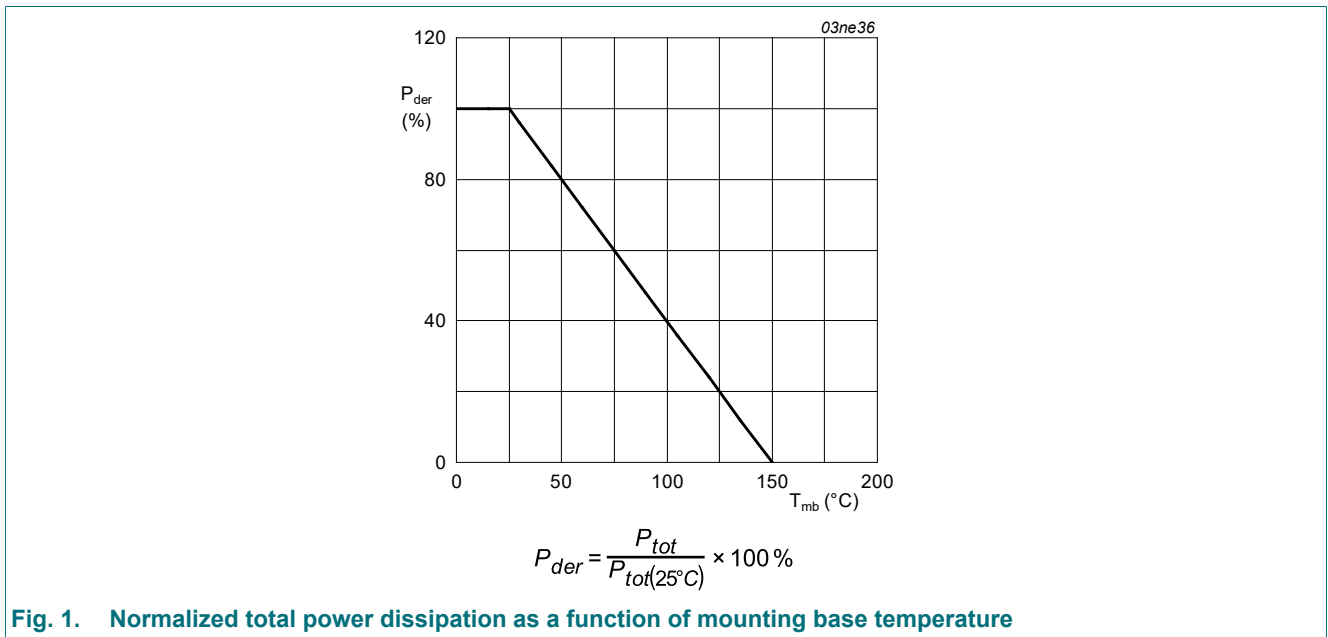
## 8. Limiting values

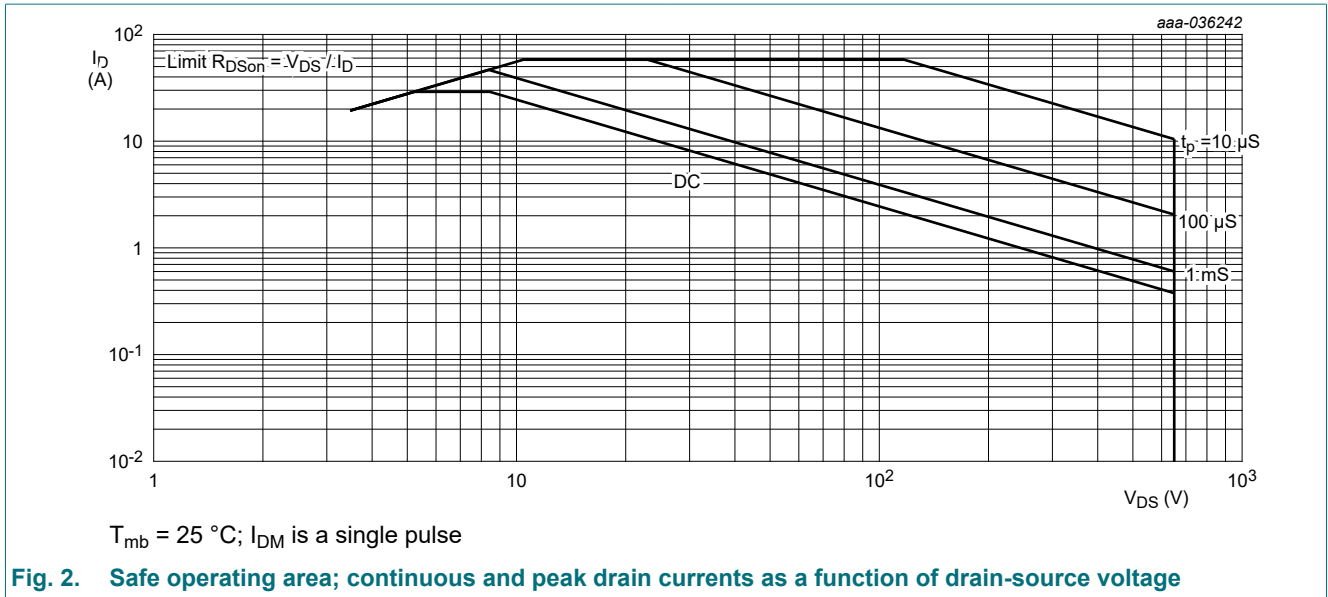
**Table 5. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).  $T_j = 25\text{ °C}$  unless otherwise stated.

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$-55\text{ °C} \leq T_j \leq 150\text{ °C}$		-	650	V
$V_{TDS}$	transient drain to source voltage	pulsed; $t_p = 1\text{ }\mu\text{s}$ ; $\delta_{factor} = 0.01$		-	800	V
$V_{GS}$	gate-source voltage			-6	7	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>		-	240	W
$I_D$	drain current	$V_{GS} = 6\text{ V}$ ; $T_{mb} = 25\text{ °C}$	[1]	-	29	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	58	A
$T_{stg}$	storage temperature			-55	150	°C
$T_j$	junction temperature			-55	150	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C

[1] Limited by device saturation





### 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	Fig. 3	-	-	0.52	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient		-	-	33.6	K/W

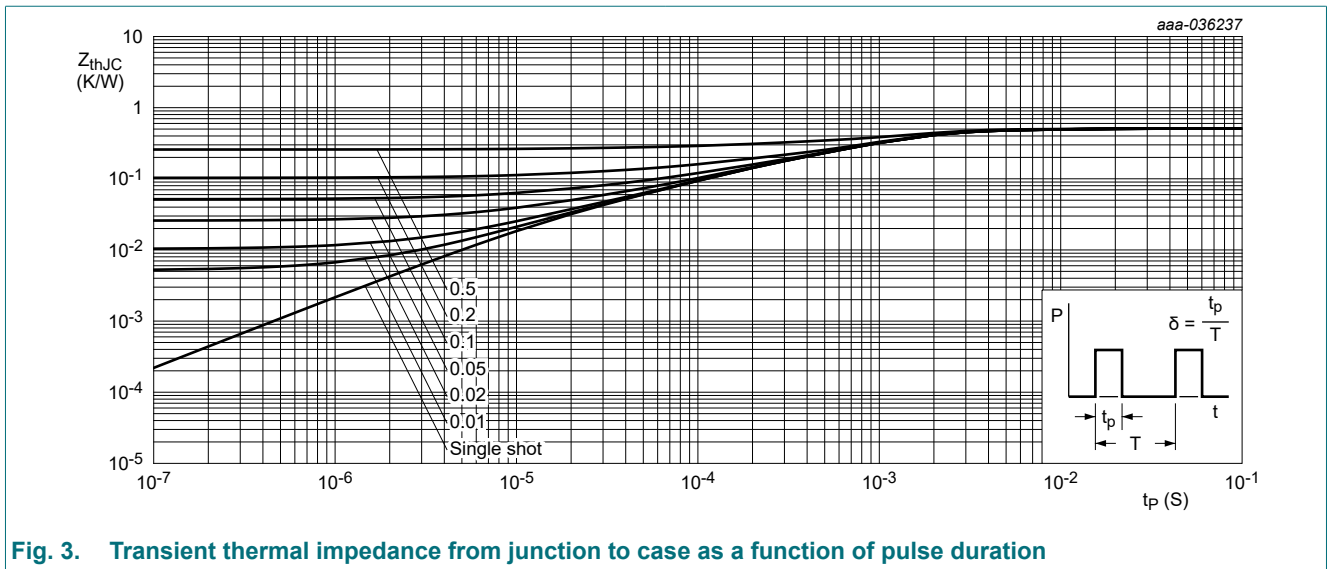


Fig. 3. Transient thermal impedance from junction to case as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 30.7 \text{ mA}$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>	1.2	1.7	2.5	V
		$I_D = 30.7 \text{ mA}$ ; $V_{DS} = V_{GS}$ ; $T_j = 150 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 8</a>	-	1.6	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 650 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 9</a>	-	1	65	$\mu\text{A}$
		$V_{DS} = 650 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 150 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 9</a>	-	13	390	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 6 \text{ V}$ ; $V_{DS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 10</a>	-	163	-	$\mu\text{A}$
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 6 \text{ V}$ ; $I_D = 8 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 11</a> ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	60	80	m $\Omega$
		$V_{GS} = 6 \text{ V}$ ; $I_D = 8 \text{ A}$ ; $T_j = 150 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 11</a> ; <a href="#">Fig. 14</a>	-	135	-	m $\Omega$
$R_G$	gate resistance	$f = 5 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; open drain	-	3	-	$\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 8 \text{ A}$ ; $V_{DS} = 400 \text{ V}$ ; $V_{GS} = 6 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 15</a> ; <a href="#">Fig. 16</a>	-	6.2	-	nC
$Q_{GS}$	gate-source charge		-	0.5	-	nC
$Q_{GD}$	gate-drain charge		-	2.2	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 8 \text{ A}$ ; $V_{DS} = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 15</a>	-	2.2	-	V
$C_{iss}$	input capacitance	$V_{DS} = 400 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $f = 100 \text{ kHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 17</a>	-	225	-	pF
$C_{oss}$	output capacitance		-	70	-	pF
$C_{rss}$	reverse transfer capacitance		-	0.5	-	pF
$C_{o(er)}$	effective output capacitance, energy related	$0 \text{ V} \leq V_{DS} \leq 400 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 18</a>	[1]	105	-	pF
$C_{o(tr)}$	effective output capacitance, time related	$0 \text{ V} \leq V_{DS} \leq 400 \text{ V}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	[2]	150	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 400 \text{ V}$ ; $V_{GS} = 6 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; $I_D = 16 \text{ A}$ ; $L = 318 \text{ } \mu\text{H}$ ; $R_{on} = 10 \text{ } \Omega$ ; $R_{off} = 2 \text{ } \Omega$ ; <a href="#">Fig. 19</a> ; <a href="#">Fig. 20</a>	-	3	-	ns
$t_r$	rise time		-	4	-	ns
$t_{d(off)}$	turn-off delay time		-	5	-	ns
$t_f$	fall time		-	4	-	ns
$Q_{oss}$	output charge	$V_{GS} = 0 \text{ V}$ ; $V_{DS} = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	[3]	60	-	nC
<b>Source-drain characteristics</b>						
$V_{SD}$	source-drain voltage	$I_S = 8 \text{ A}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 21</a> ; <a href="#">Fig. 22</a> ; <a href="#">Fig. 23</a> ; <a href="#">Fig. 24</a>	-	2.3	-	V

[1]  $C_{o(er)}$  is the fixed capacitance that gives the same stored energy as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 400 V

[2]  $C_{o(tr)}$  is the fixed capacitance that gives the same charging time as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 400 V

[3]  $Q_r$  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.)

650 V, 80 mOhm Gallium Nitride (GaN) FET in a DFN 8 mm x 8 mm package

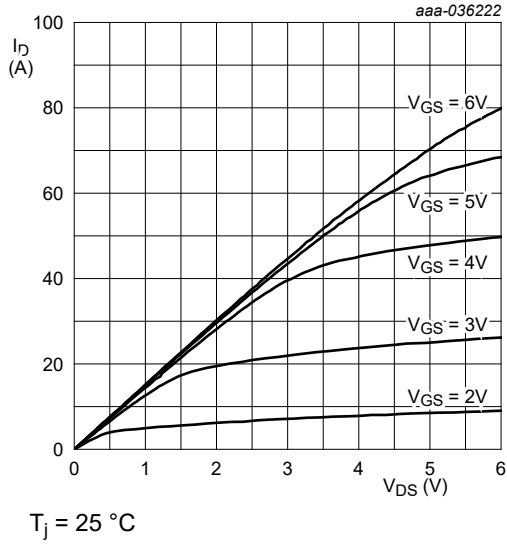


Fig. 4. Output characteristics: drain current as a function of drain-source voltage; typical values

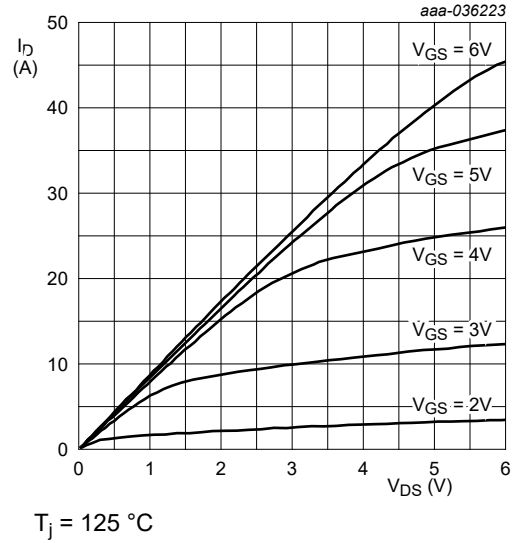


Fig. 5. Output characteristics: drain current as a function of drain-source voltage; typical values

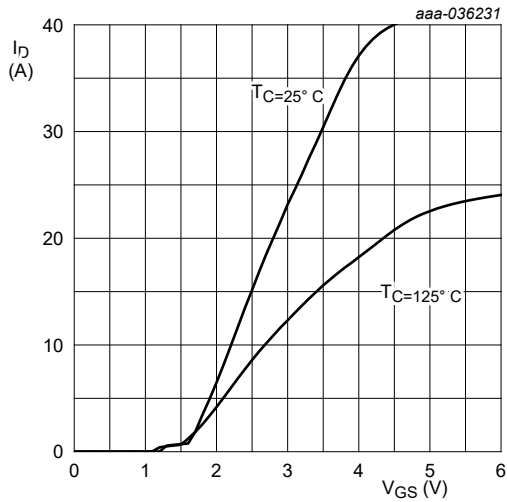


Fig. 6. Transfer characteristics; drain current as a function of gate-source voltage; typical values

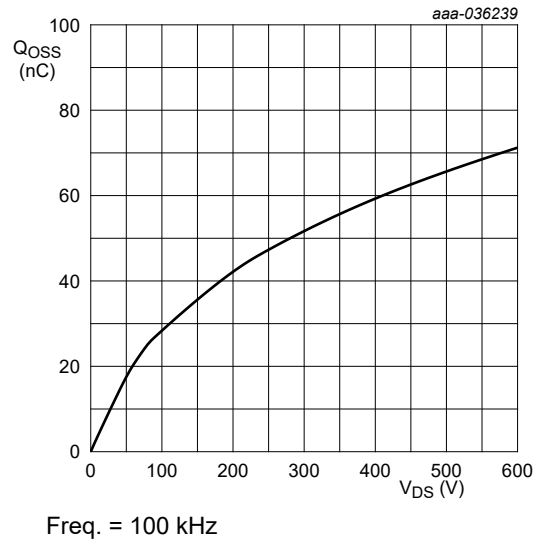
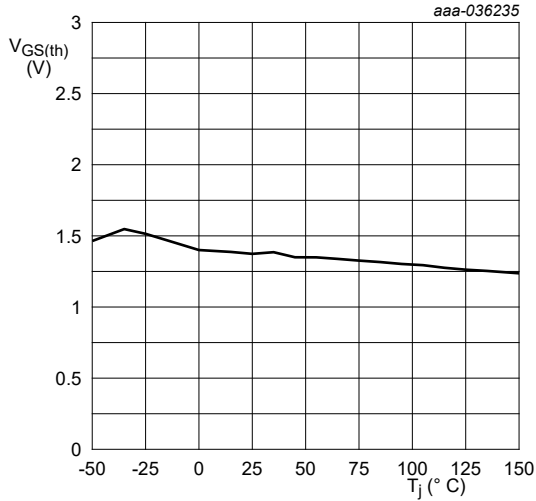
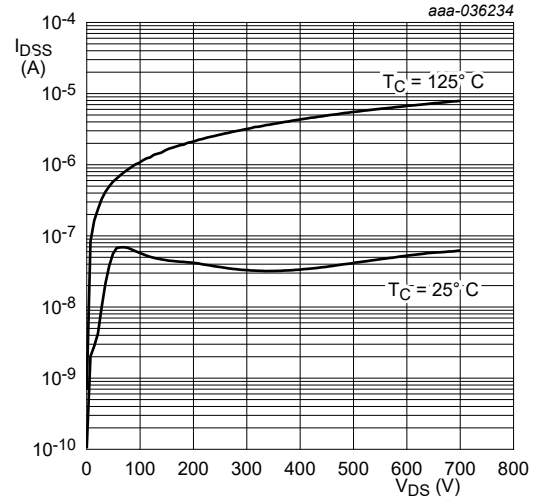


Fig. 7. Output charge as a function of drain-source voltage; typical values



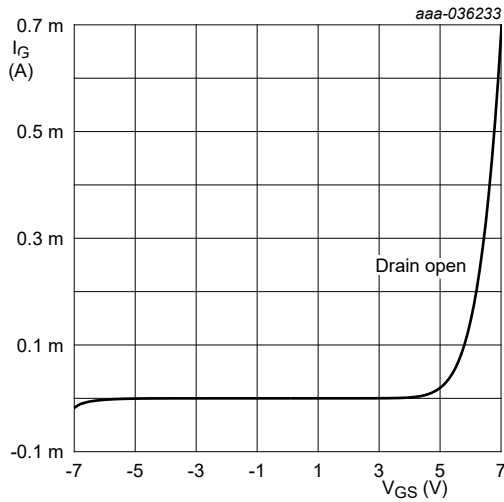
$V_{GS} = V_{DS}$  ;  $I_D = 30.7 \text{ mA}$

Fig. 8. Gate-source threshold voltage as a function of junction temperature



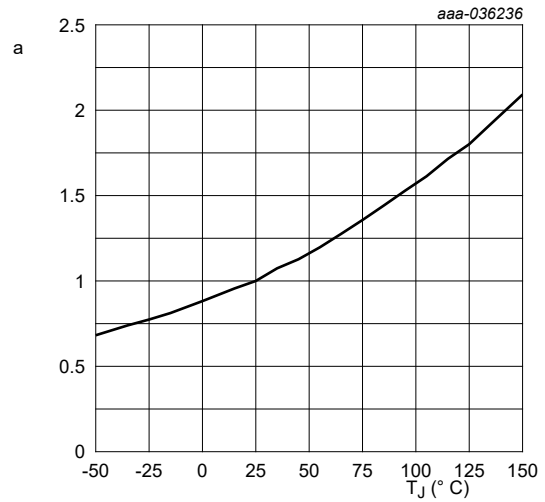
$V_{GS} = 0 \text{ V}$

Fig. 9. Drain-source current as a function of drain-source voltage; typical values



Ig reverse turn on by ESD unit

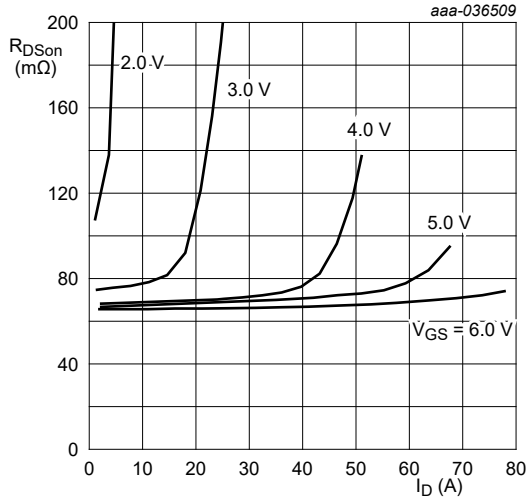
Fig. 10. Gate-source current as a function of gate-source voltage; typical values



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

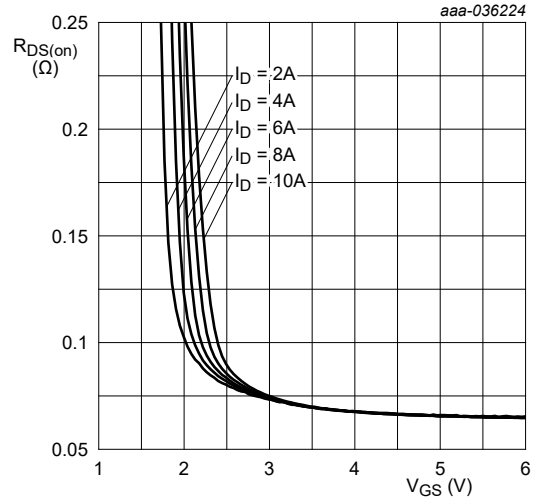
Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

650 V, 80 mOhm Gallium Nitride (GaN) FET in a DFN 8 mm x 8 mm package



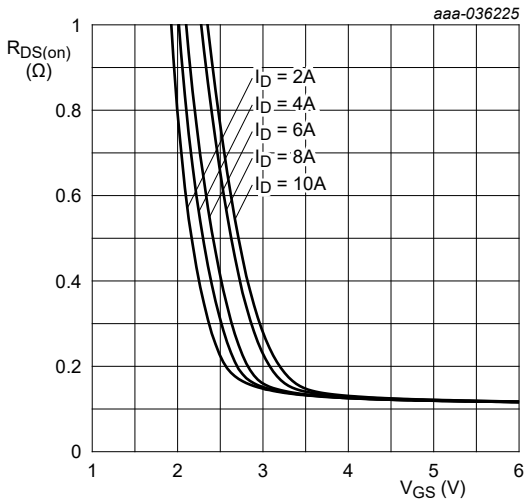
$T_j = 25^\circ\text{C}$

Fig. 12. Drain-source on-state resistance as a function of drain current ; typical values



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

Fig. 13. Drain-source on-state resistance as a function of gate-source voltage; typical values



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

Fig. 14. Drain-source on-state resistance as a function of gate-source voltage; typical values

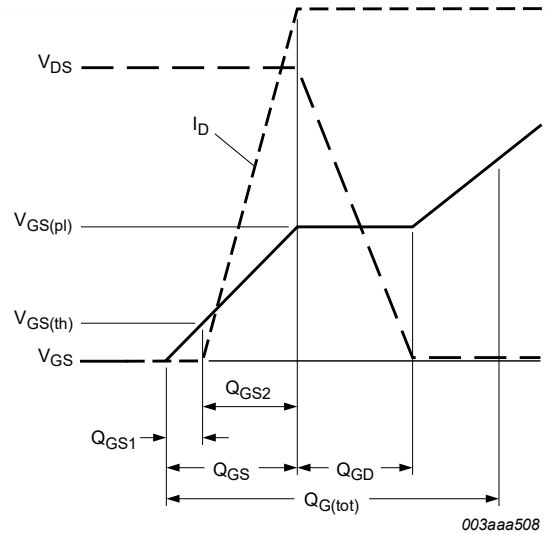
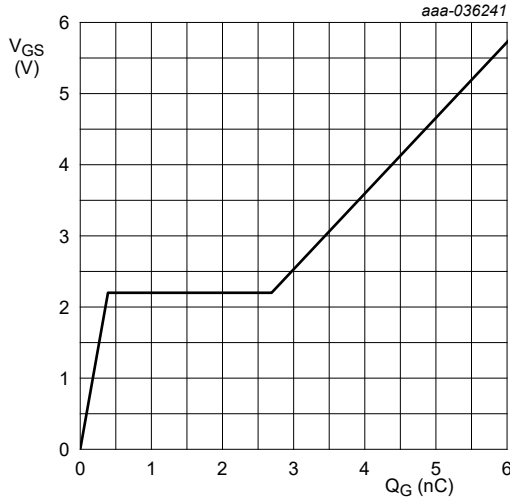


Fig. 15. Gate charge waveform definitions

650 V, 80 mOhm Gallium Nitride (GaN) FET in a DFN 8 mm x 8 mm package



$T_J = 25\text{ }^\circ\text{C}$ ;  $I_D = 8\text{ A}$

Fig. 16. Gate-source voltage as a function of gate charge; typical values

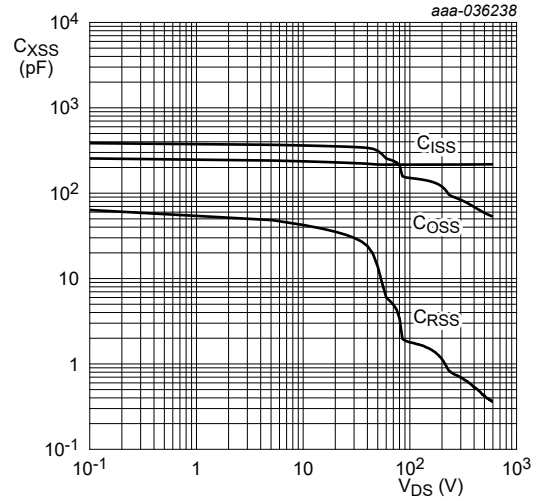
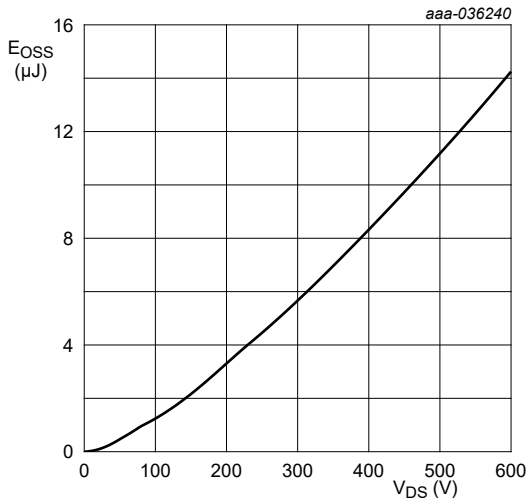
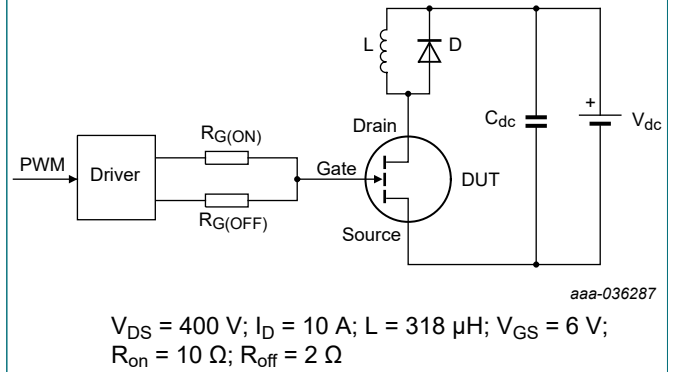


Fig. 17. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



Freq. = 100 kHz

Fig. 18. COSS stored energy as a function of drain-source voltage; typical values



$V_{DS} = 400\text{ V}$ ;  $I_D = 10\text{ A}$ ;  $L = 318\text{ }\mu\text{H}$ ;  $V_{GS} = 6\text{ V}$ ;  
 $R_{on} = 10\text{ }\Omega$ ;  $R_{off} = 2\text{ }\Omega$

Fig. 19. Typical switching times with inductive load

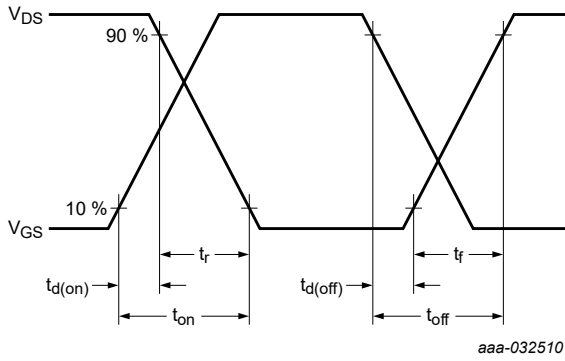
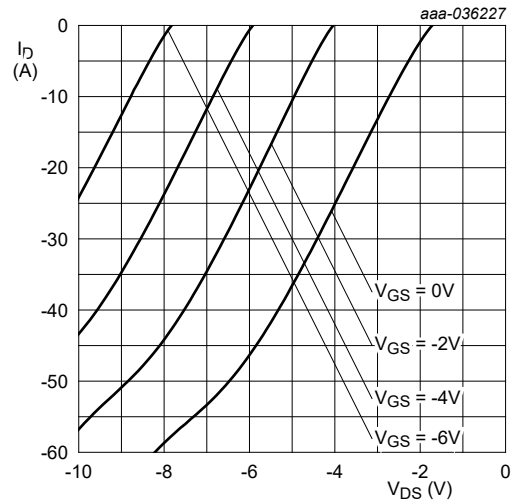
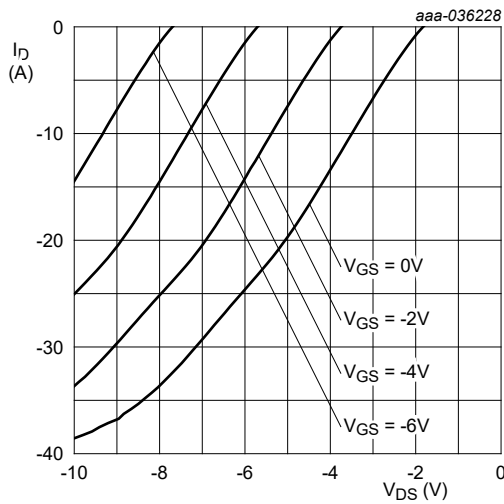


Fig. 20. Switching time waveform



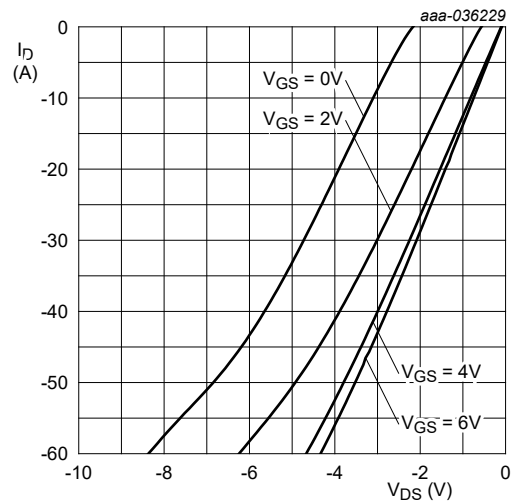
$T_j = 25\text{ °C}$

Fig. 21. Source current as a function of source-drain voltage; typical values



$T_j = 125\text{ °C}$

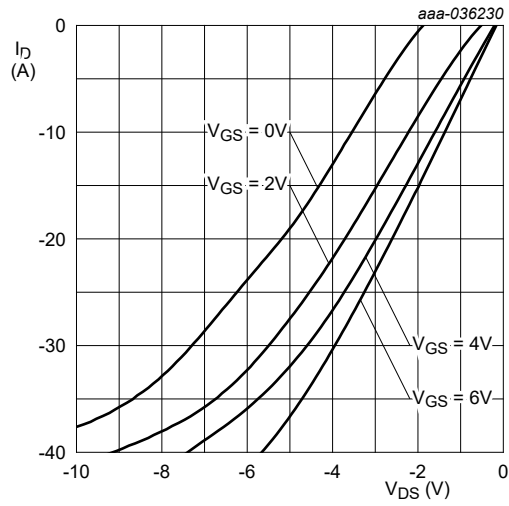
Fig. 22. Source current as a function of source-drain voltage; typical values



$T_j = 25\text{ °C}$

Fig. 23. Source current as a function of source-drain voltage; typical values

650 V, 80 mOhm Gallium Nitride (GaN) FET in a DFN 8 mm x 8 mm package



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

Fig. 24. Source current as a function of source-drain voltage; typical values

### 11. Package outline

DFN8080-8: plastic thermal enhanced small outline package; no leads; 8 terminals; body: 8 × 8 × 0.9 mm

SOT8074-1

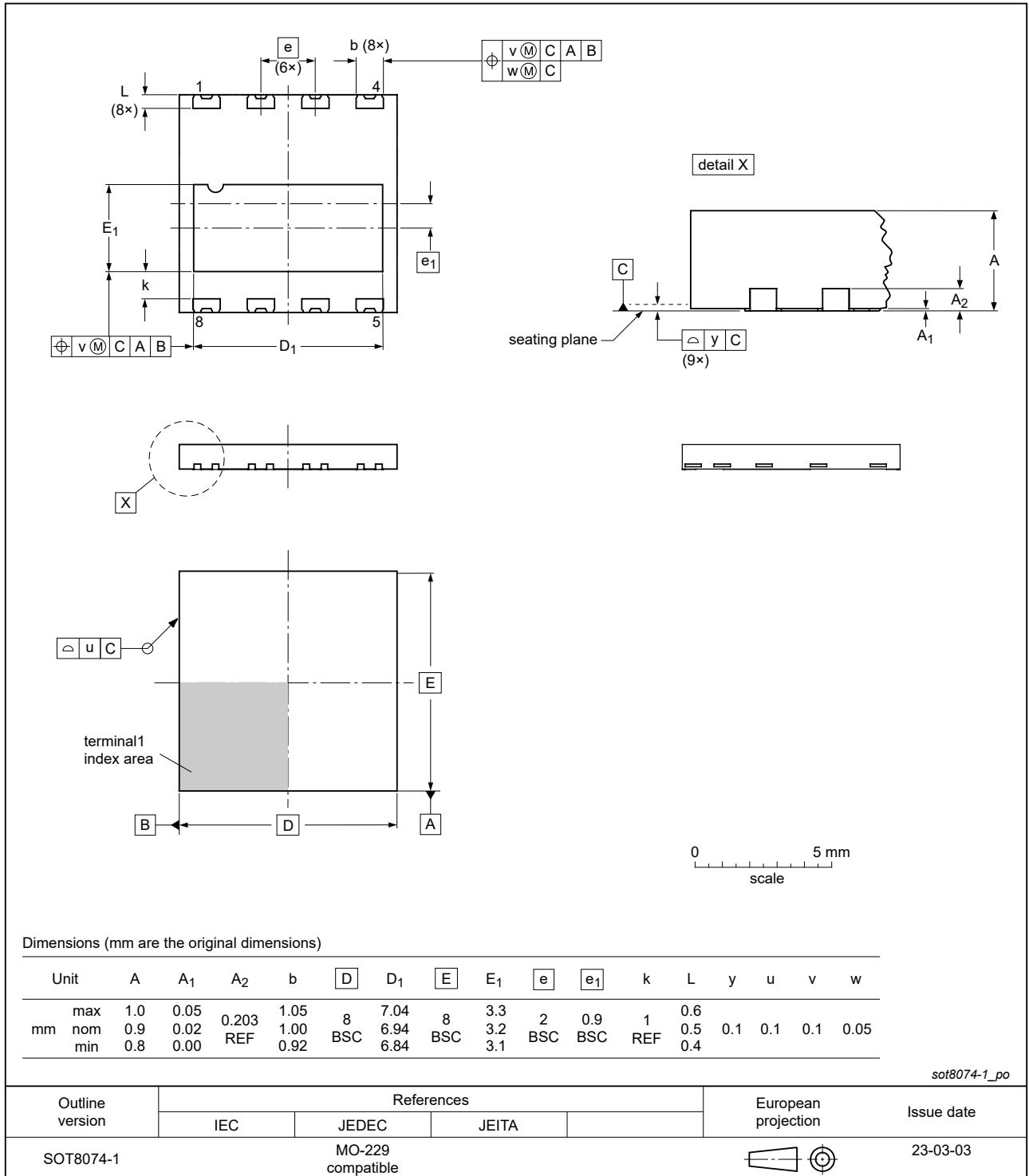


Fig. 25. Package outline DFN8080-8 (SOT8074-1)

## 12. Soldering

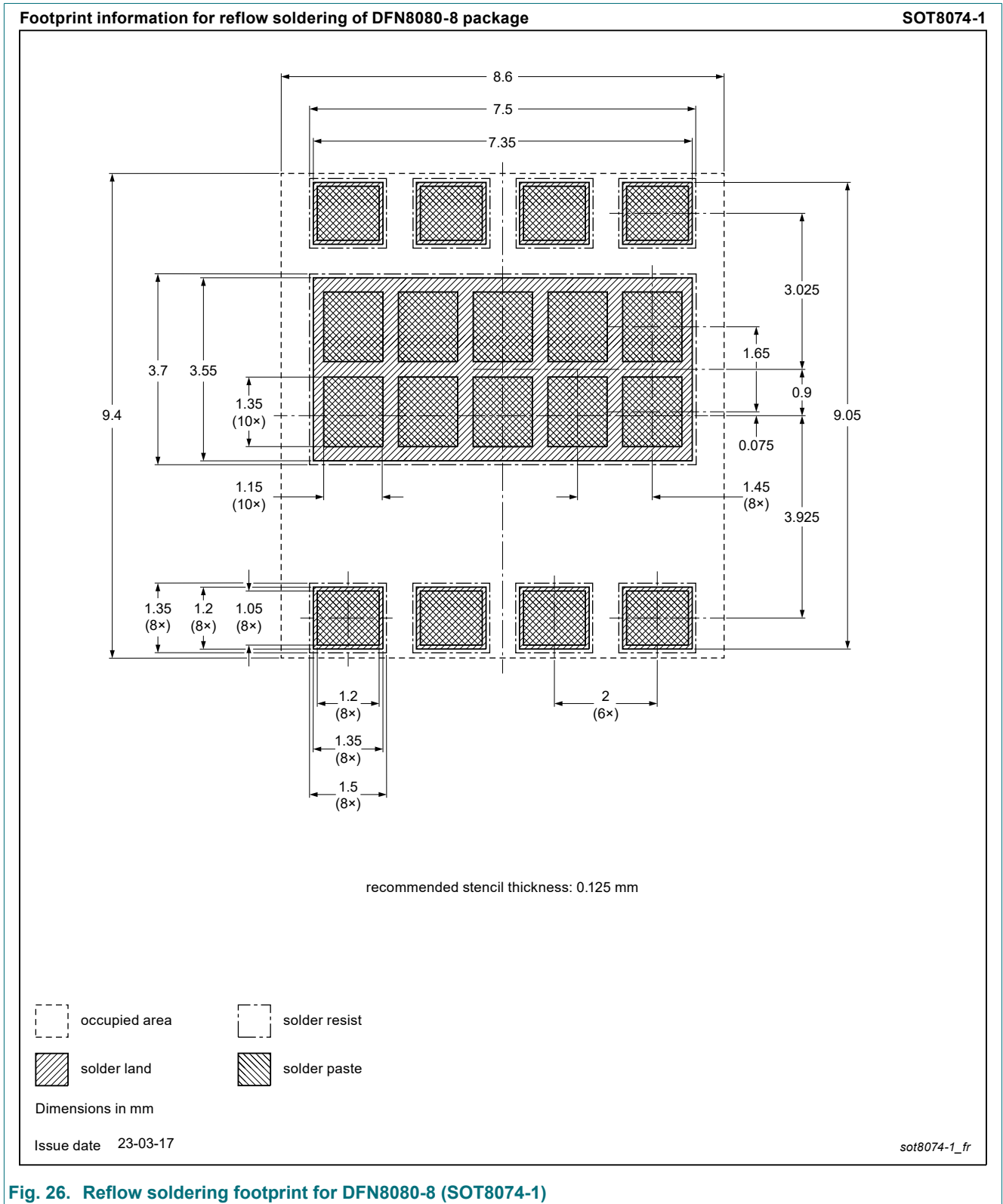


Fig. 26. Reflow soldering footprint for DFN8080-8 (SOT8074-1)

## 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.

- [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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## Contents

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1. General description.....	1
2. Features and benefits.....	1
3. Applications.....	1
4. Quick reference data.....	1
5. Pinning information.....	2
6. Ordering information.....	2
7. Marking.....	2
8. Limiting values.....	3
9. Thermal characteristics.....	4
10. Characteristics.....	5
11. Package outline.....	12
12. Soldering.....	13
13. Legal information.....	14

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