



# PBSS4310PAS-Q

10 V, 3 A NPN low V<sub>CEsat</sub> transistor

21 January 2022

Product data sheet

## 1. General description

NPN low V<sub>CEsat</sub> transistor, encapsulated in an ultra thin SOT1061D (DFN2020D-3) leadless small Surface-Mounted Device (SMD) plastic package with medium power capability and side-wettable flanks (SWF).

## 2. Features and benefits

- Very low collector-emitter saturation voltage V<sub>CEsat</sub>
- High collector current capability I<sub>C</sub> and I<sub>CM</sub>
- High collector current gain (h<sub>FE</sub>) at high I<sub>C</sub>
- High efficiency due to less heat generation
- High temperature applications up to 175 °C
- Reduced Printed-Circuit Board (PCB) area requirements
- Leadless small SMD plastic package with solderable side pads
- Exposed heat sink for excellent thermal and electrical conductivity
- Suitable for Automatic Optical Inspection (AOI) of solder joint
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- Linear voltage regulation
- Loadswitch
- Battery-driven devices
- Power management
- Charging circuits
- Power switches (e.g. motors, fans)

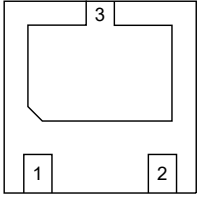
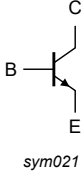
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CEO</sub>	collector-emitter voltage	open base	-	-	10	V
I <sub>C</sub>	collector current		-	-	3	A
h <sub>FE</sub>	DC current gain	V <sub>CE</sub> = 2 V; I <sub>C</sub> = 100 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	325	-	-	
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = 1 A; I <sub>B</sub> = 10 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	-	55	mV

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>Transparent top view DFN2020D-3 (SOT1061D)</p>	 <p>sym021</p>
2	E	emitter		
3	C	collector		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBSS4310PAS-Q	DFN2020D-3	plastic, leadless thermal enhanced ultra thin small outline package with side-wettable flanks (SWF); no leads; 3 terminals; 1.3 mm pitch; 2 mm x 2 mm x 0.65 mm body	SOT1061D

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PBSS4310PAS-Q	F2

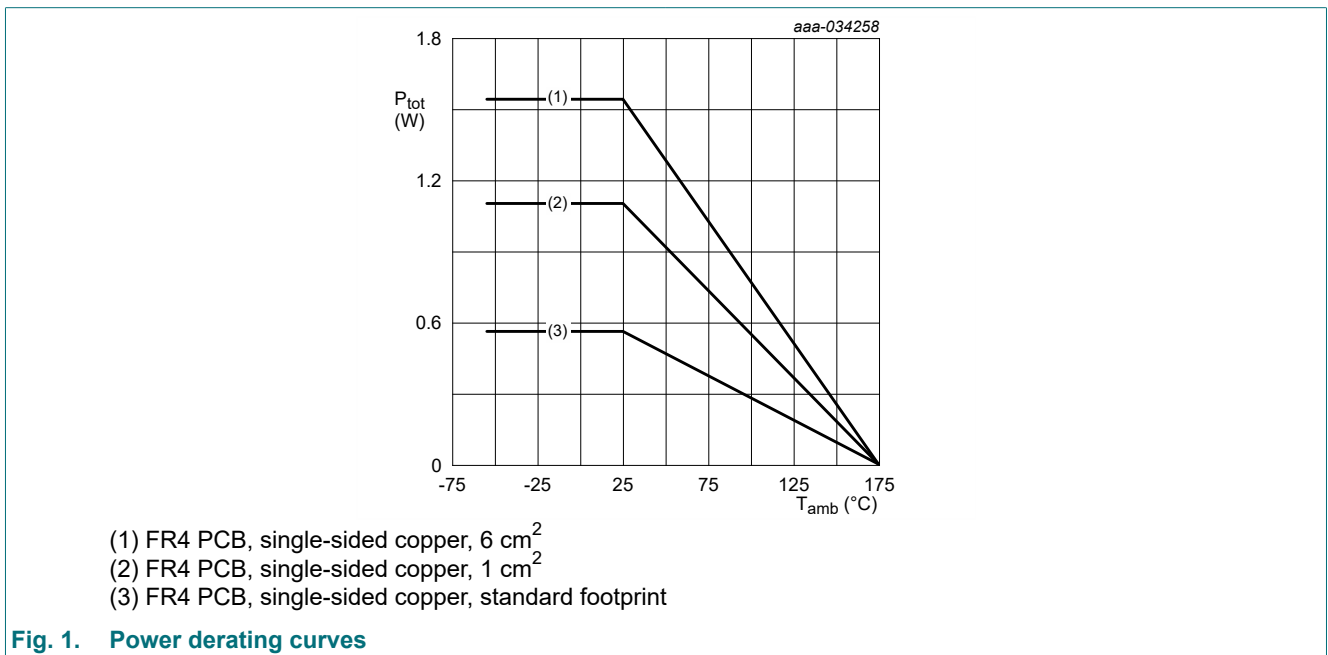
## 8. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter		-	10	V
$V_{CEO}$	collector-emitter voltage	open base		-	10	V
$V_{EBO}$	emitter-base voltage	open collector		-	8	V
$I_C$	collector current			-	3	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	5	A
$I_B$	base current			-	500	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	560	mW
			[2]	-	1.1	W
			[3]	-	1.54	W
$T_j$	junction temperature			-	175	°C
$T_{amb}$	ambient temperature			-55	175	°C
$T_{stg}$	storage temperature			-65	175	°C

- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.



**Fig. 1. Power derating curves**

## 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]	-	-	268	K/W
			[2]	-	-	137	K/W
			[3]	-	-	98	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	7	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 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.

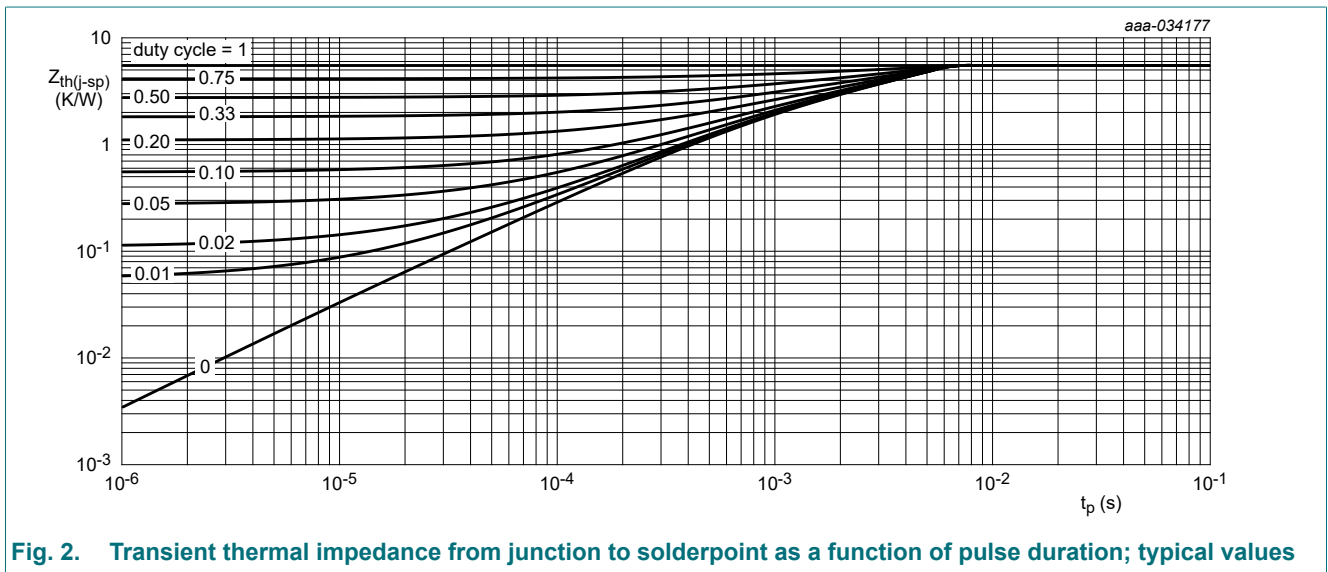


Fig. 2. Transient thermal impedance from junction to solderpoint as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100 \mu\text{A}; I_E = 0 \text{ A}$	10	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10 \text{ mA}; I_B = 0 \text{ A}$	10	-	-	V
$V_{(BR)EBO}$	emitter-base breakdown voltage (collector open)	$I_E = 100 \mu\text{A}; I_C = 0 \text{ A}$	8	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 8 \text{ V}; I_E = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	100	nA
		$V_{CB} = 8 \text{ V}; I_E = 0 \text{ A}; T_J = 125 \text{ }^\circ\text{C}$	-	-	50	$\mu\text{A}$
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = 8 \text{ V}; V_{BE} = 0 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	100	nA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 6.4 \text{ V}; I_C = 0 \text{ A}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	100	nA
$h_{FE}$	DC current gain	$V_{CE} = 2 \text{ V}; I_C = 100 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	325	-	-	
		$V_{CE} = 2 \text{ V}; I_C = 500 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	325	-	-	
		$V_{CE} = 2 \text{ V}; I_C = 1 \text{ A}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	300	-	-	
		$V_{CE} = 2 \text{ V}; I_C = 2 \text{ A}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	275	-	-	
		$V_{CE} = 2 \text{ V}; I_C = 3 \text{ A}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	250	-	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	25	mV
		$I_C = 1 \text{ A}; I_B = 50 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	35	mV
		$I_C = 1 \text{ A}; I_B = 10 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	55	mV
		$I_C = 2 \text{ A}; I_B = 20 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	85	mV
		$I_C = 3 \text{ A}; I_B = 150 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	90	mV
		$I_C = 3 \text{ A}; I_B = 30 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	110	mV
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 1 \text{ A}; I_B = 100 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	1	V
		$I_C = 3 \text{ A}; I_B = 300 \text{ mA}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	1.2	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2 \text{ V}; I_C = 2 \text{ A}; \text{pulsed}; t_p \leq 300 \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^\circ\text{C}$	-	-	845	mV
$t_d$	delay time	$I_C = 2 \text{ A}; I_{Bon} = 100 \text{ mA}; I_{Boff} = -100 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	16	-	ns
$t_r$	rise time		-	55	-	ns
$t_s$	storage time		-	190	-	ns
$t_f$	fall time		-	48	-	ns
$f_T$	transition frequency	$V_{CE} = 5 \text{ V}; I_C = 100 \text{ mA}; f = 100 \text{ MHz}; T_{amb} = 25 \text{ }^\circ\text{C}$	-	80	-	MHz

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}$ ; $I_E = 0\text{ A}$ ; $i_e = 0\text{ A}$ ; $f = 1\text{ MHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$	-	75	-	pF

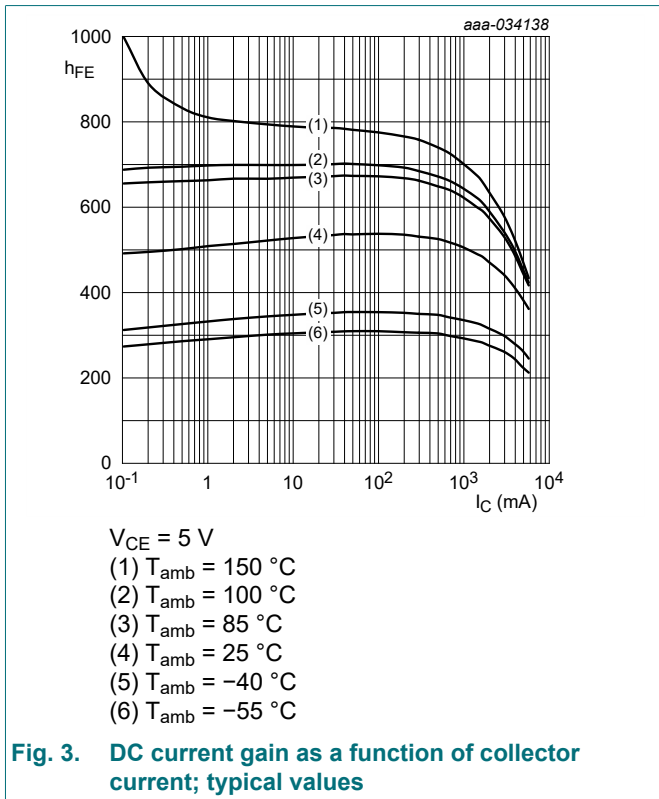


Fig. 3. DC current gain as a function of collector current; typical values

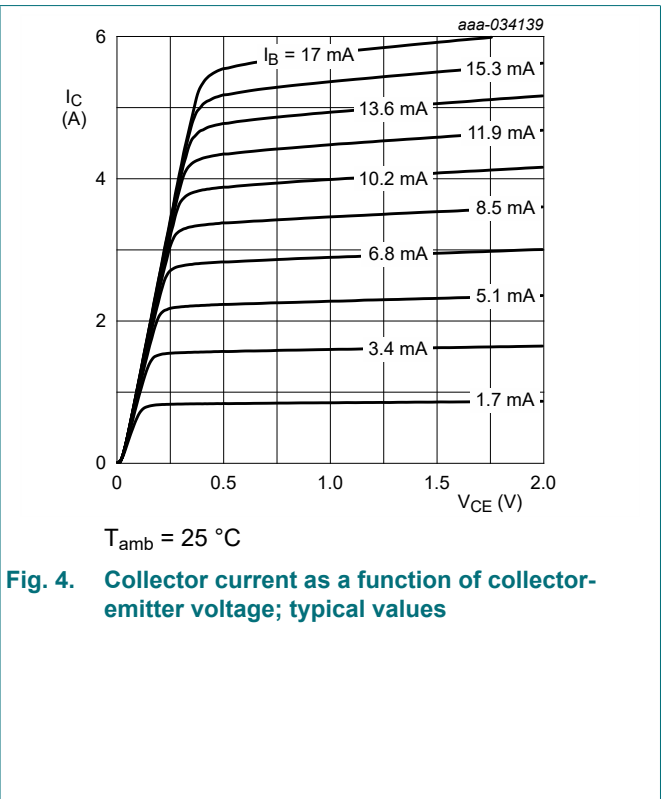


Fig. 4. Collector current as a function of collector-emitter voltage; typical values

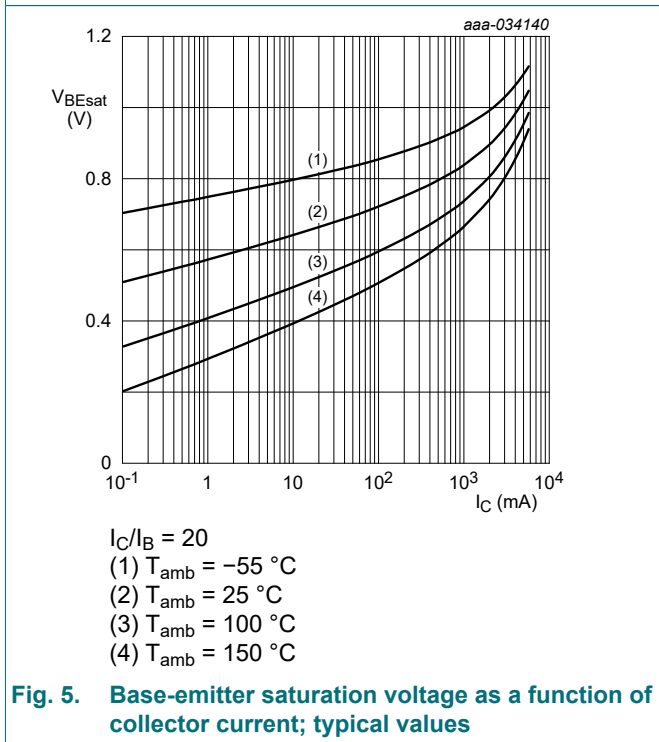


Fig. 5. Base-emitter saturation voltage as a function of collector current; typical values

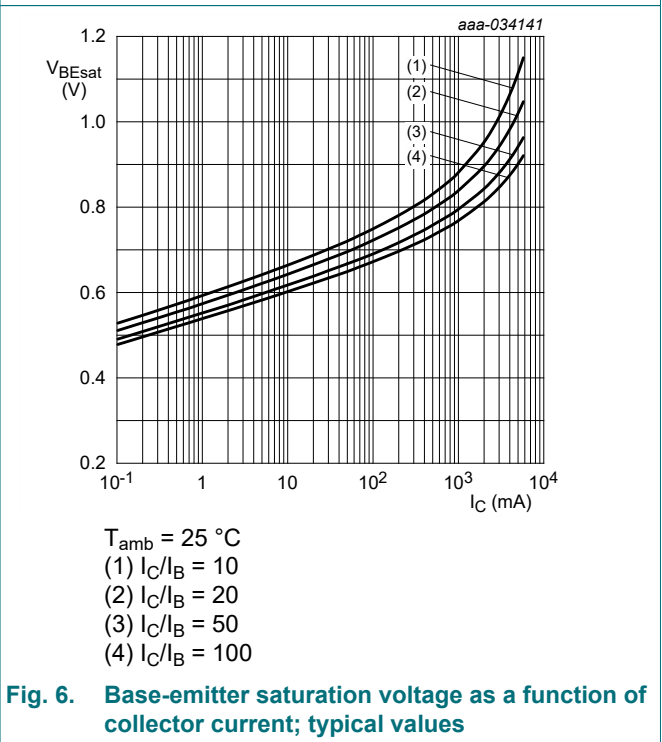
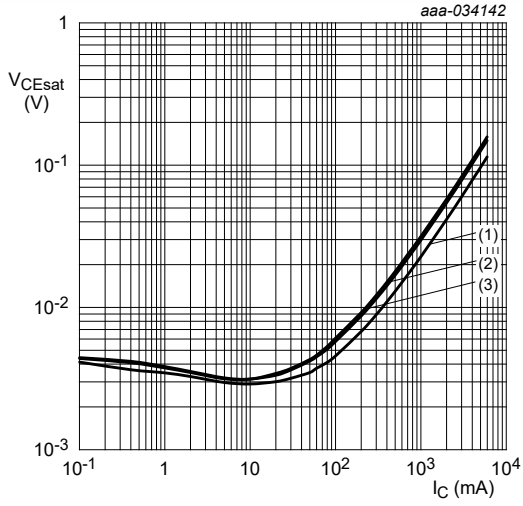
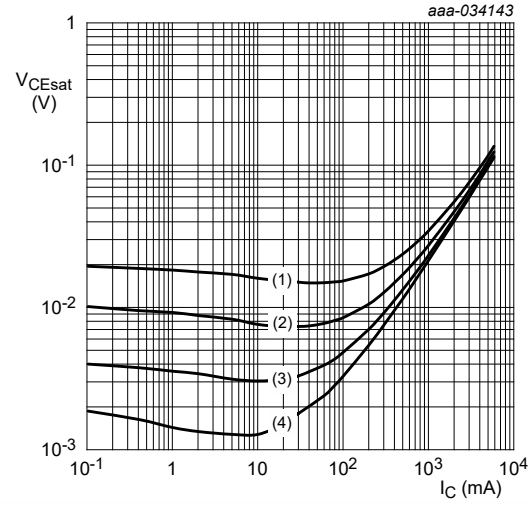


Fig. 6. Base-emitter saturation voltage as a function of collector current; typical values



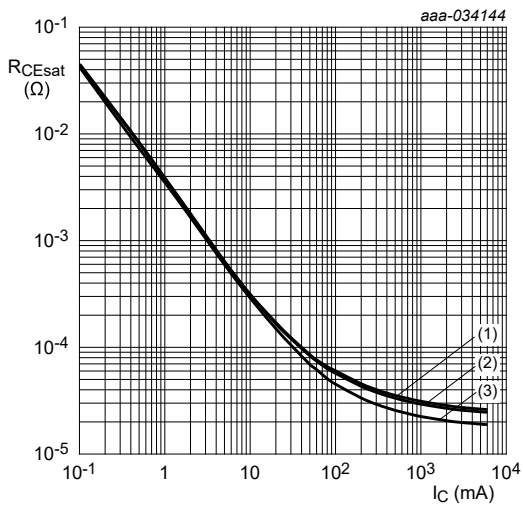
$I_C/I_B = 20$   
 (1)  $T_{amb} = 125\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

**Fig. 7. Collector-emitter saturation voltage as a function of collector current; typical values**



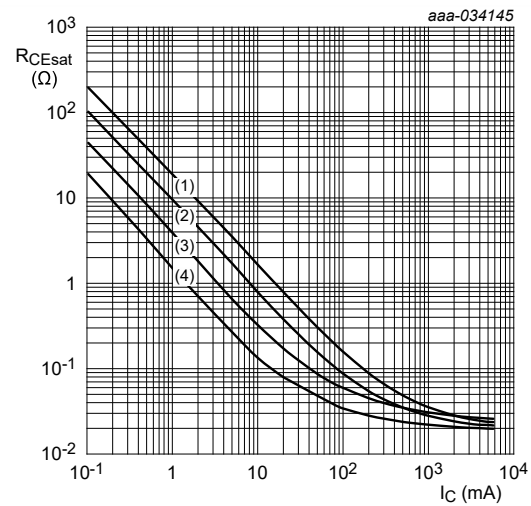
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 20$   
 (4)  $I_C/I_B = 10$

**Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values**



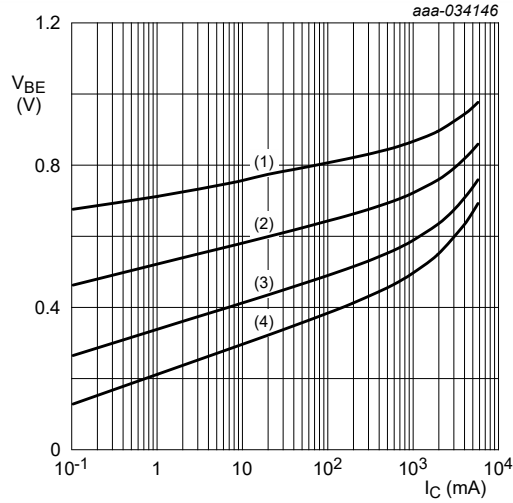
$I_C/I_B = 20$   
 (1)  $T_{amb} = 125\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

**Fig. 9. Collector-emitter saturation resistance as a function of collector current; typical values**



$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 20$   
 (4)  $I_C/I_B = 10$

**Fig. 10. Collector-emitter saturation resistance as a function of collector current; typical values**



$V_{CE} = 2\text{ V}$   
 (1)  $T_{amb} = -55\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = 100\text{ °C}$   
 (4)  $T_{amb} = 150\text{ °C}$

Fig. 11. Base-emitter voltage as a function of collector current; typical values



### 11. Test information

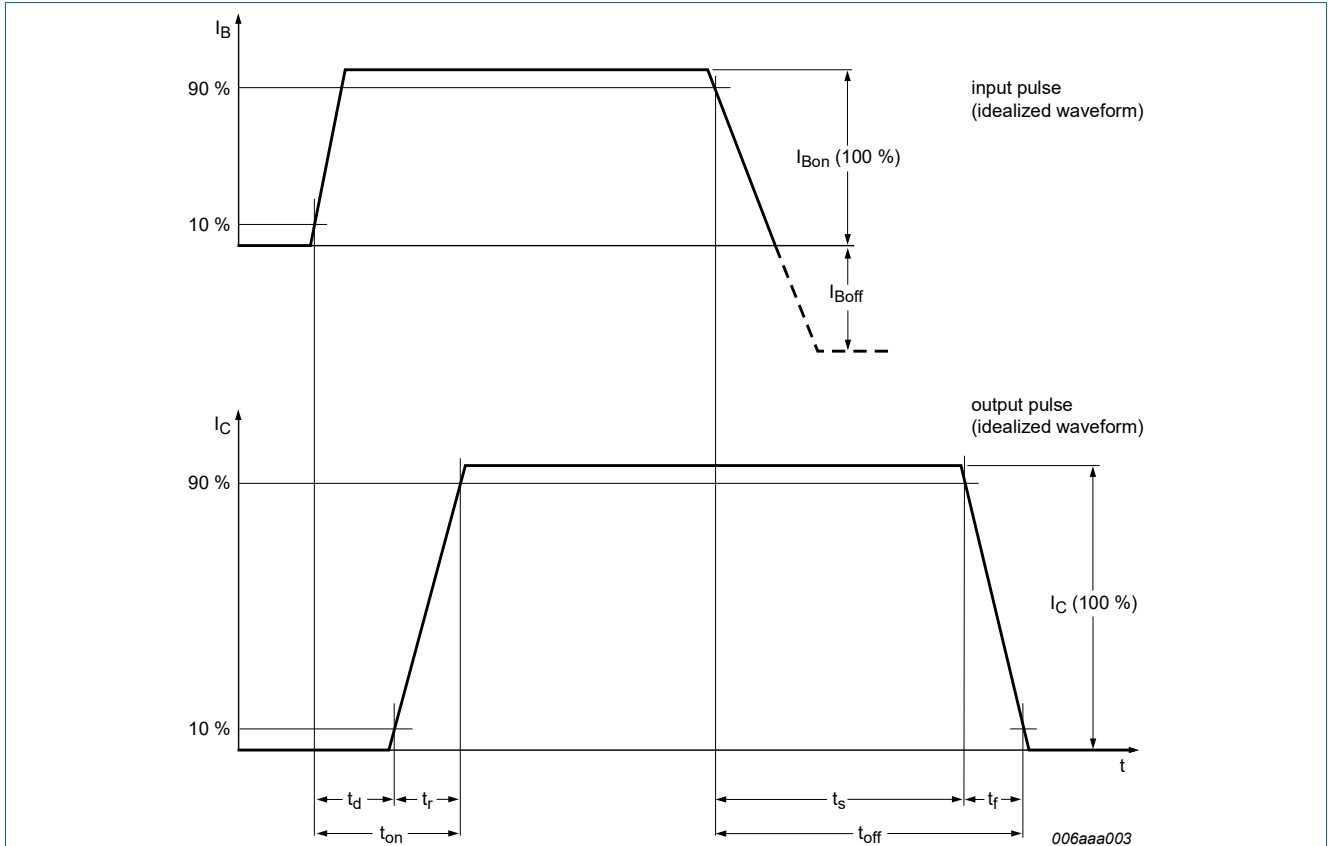


Fig. 12. Switching time definition

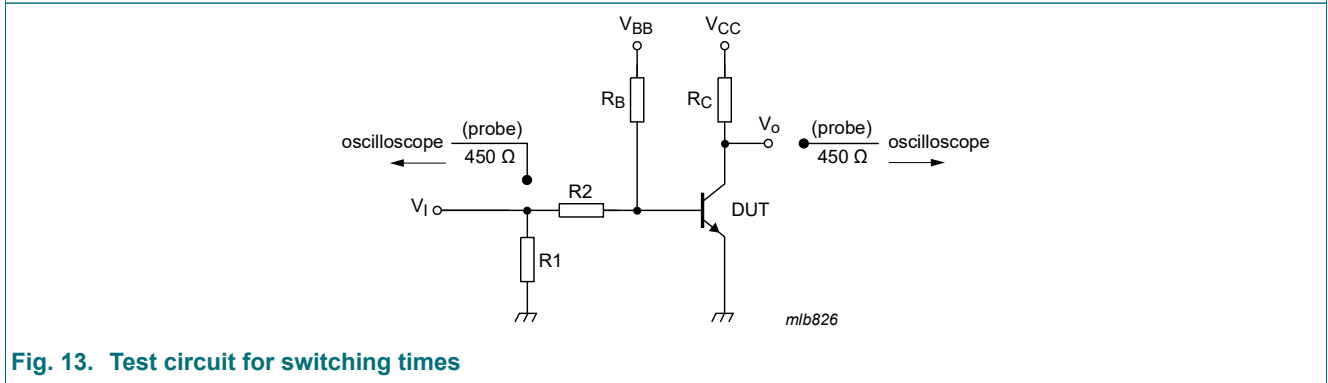


Fig. 13. Test circuit for switching times

### 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

DFN2020D-3: plastic thermal enhanced ultra thin small outline package; no leads;  
3 terminals; body 2 x 2 x 0.65 mm

SOT1061D

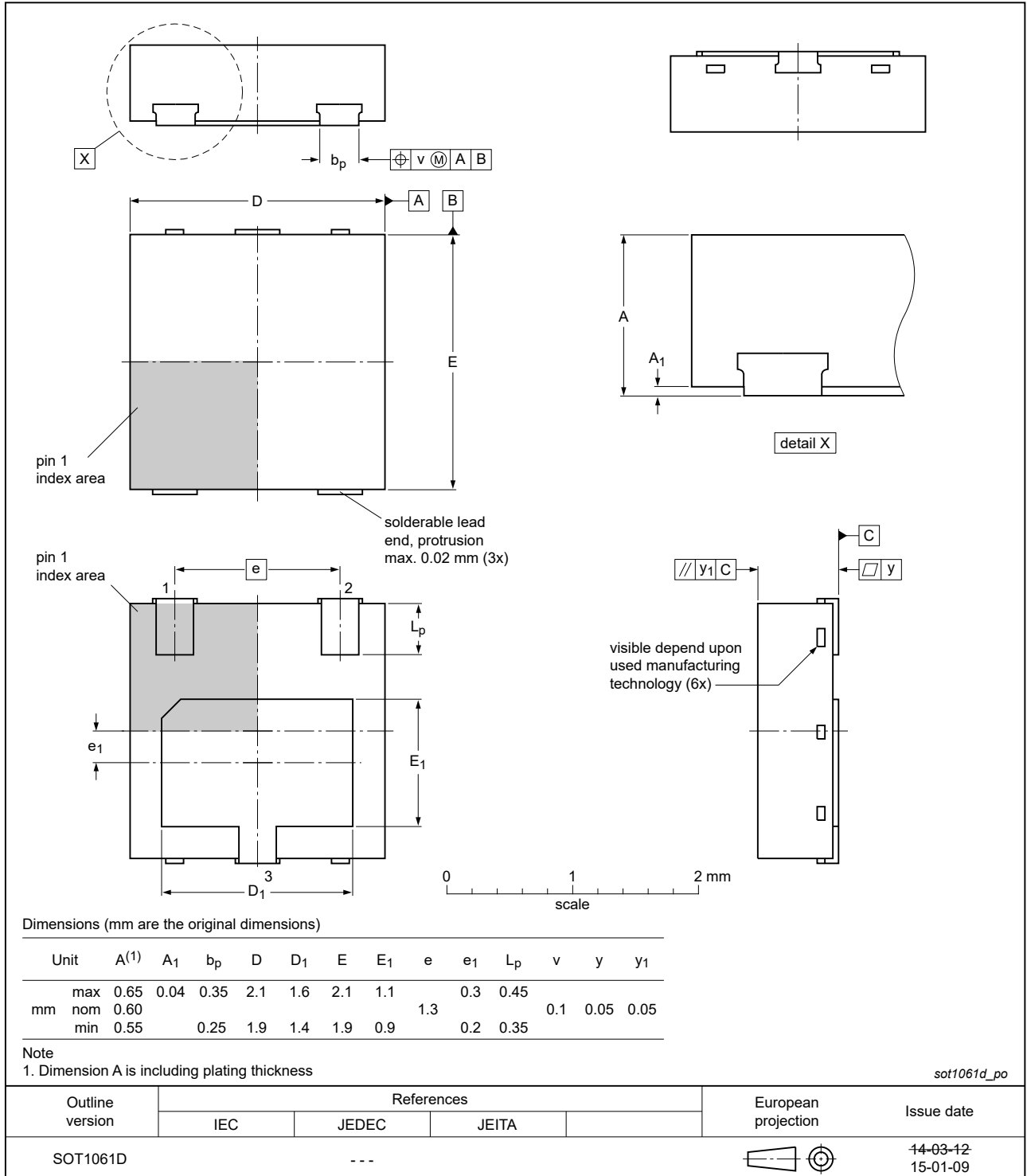


Fig. 14. Package outline DFN2020D-3 (SOT1061D)

### 13. Soldering

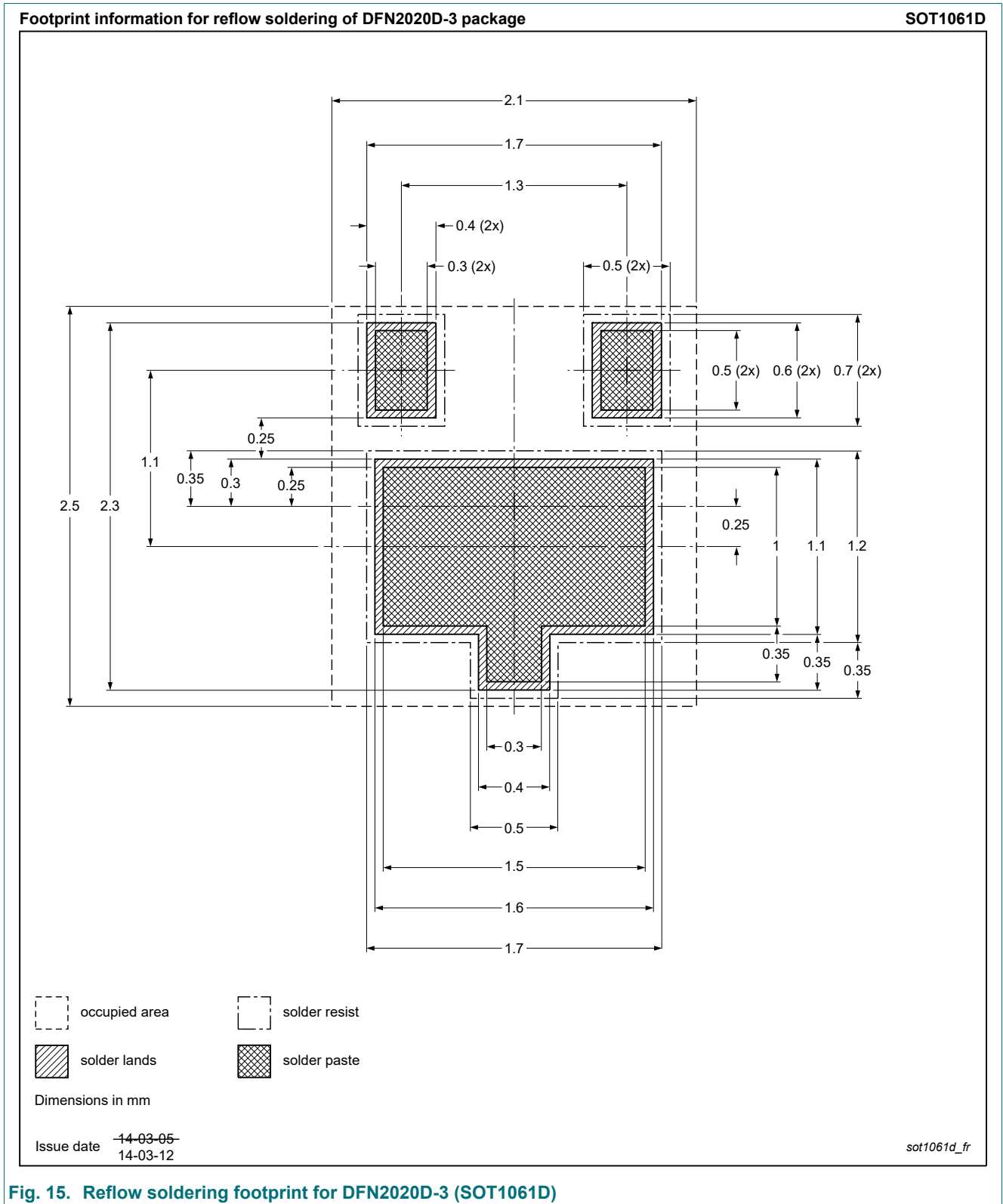


Fig. 15. Reflow soldering footprint for DFN2020D-3 (SOT1061D)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4310PAS-Q v.3	20220121	Product data sheet	-	PBSS4310PAS-Q v.1
Modifications:	• Characteristics: Figure 8 corrected			
PBSS4310PAS-Q v.2	20211215	Product data sheet	-	PBSS4310PAS-Q v.1
PBSS4310PAS-Q v.1	20211203	Preliminary 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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Date of release: 21 January 2022

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