



# PBSS4021NX

20 V, 7 A NPN low V<sub>CEsat</sub> transistor

16 January 2025

Product data sheet

## 1. General description

NPN low V<sub>CEsat</sub> transistor in a medium power and flat lead SOT89 (SC-62) Surface-Mounted Device (SMD) plastic package.

PNP complement: PBSS4021PX

## 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 energy efficiency due to less heat generation
- AEC-Q101 qualified

## 3. Applications

- 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	-	-	20	V
I <sub>C</sub>	collector current		-	-	7	A
I <sub>CM</sub>	peak collector current	single pulse; t <sub>p</sub> ≤ 1 ms	-	-	15	A
R <sub>CEsat</sub>	collector-emitter saturation resistance	I <sub>C</sub> = 5 A; I <sub>B</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	15	28	mΩ

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E	emitter	 SOT89	 sym042
2	C	collector		
3	B	base		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBSS4021NX	SOT89	plastic, surface-mounted package; 3 leads; 1.5 mm pitch; 4.5 mm x 2.5 mm x 1.5 mm body	SOT89

7. Marking

Table 4. Marking codes

Type number	Marking code[1]
PBSS4021NX	% 6 D

[1] % = placeholder for manufacturing site code

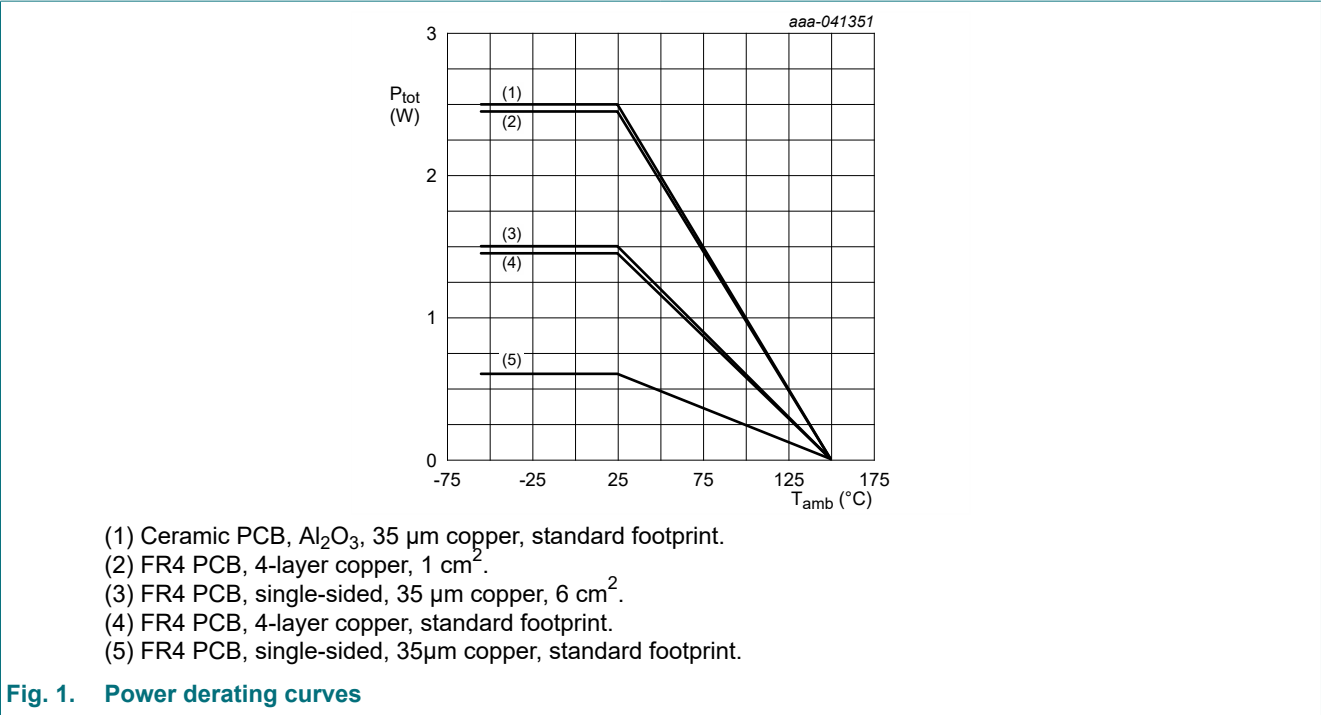
8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V <sub>CBO</sub>	collector-base voltage	open emitter		-	20	V
V <sub>CEO</sub>	collector-emitter voltage	open base		-	20	V
V <sub>EBO</sub>	emitter-base voltage	open collector		-	5	V
I <sub>C</sub>	collector current			-	7	A
I <sub>CM</sub>	peak collector current	single pulse; t <sub>p</sub> ≤ 1 ms		-	15	A
I <sub>B</sub>	base current			-	1	A
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	600	mW
			[2]	-	1.5	W
			[3]	-	1.45	W
			[4]	-	2.45	W
			[5]	-	2.5	W
T <sub>j</sub>	junction temperature			-	150	°C
T <sub>amb</sub>	ambient temperature			-55	150	°C
T <sub>stg</sub>	storage temperature			-65	150	°C

- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided, 35 µm copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided, 35 µm copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.
- [3] Device mounted on an FR4 PCB, 4-layer, tin-plated and standard footprint.
- [4] Device mounted on an FR4 PCB, 4-layer, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.
- [5] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, single-sided, 35 µm copper, tin-plated and standard footprint.

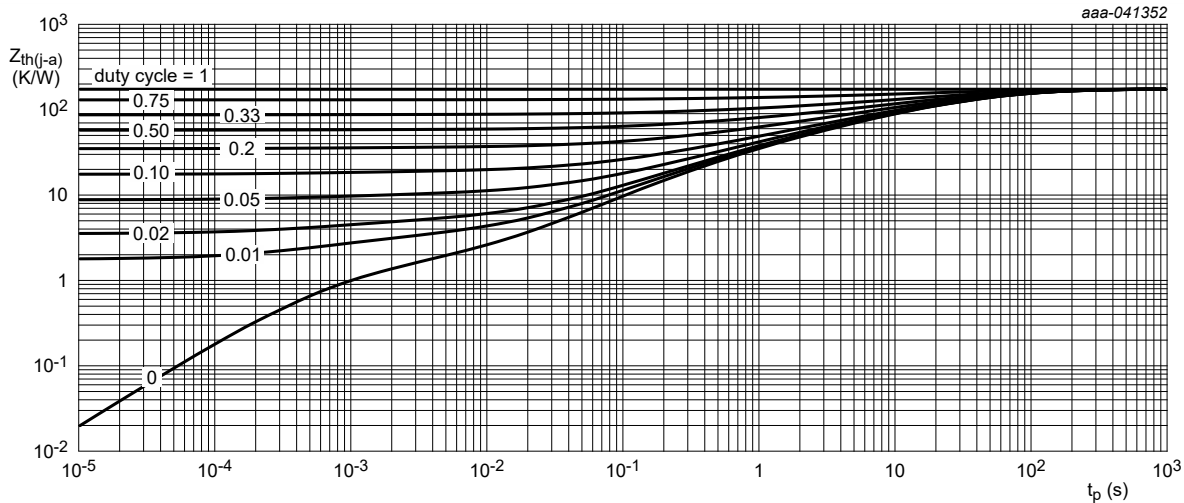


9. Thermal characteristics

Table 6. Thermal characteristics

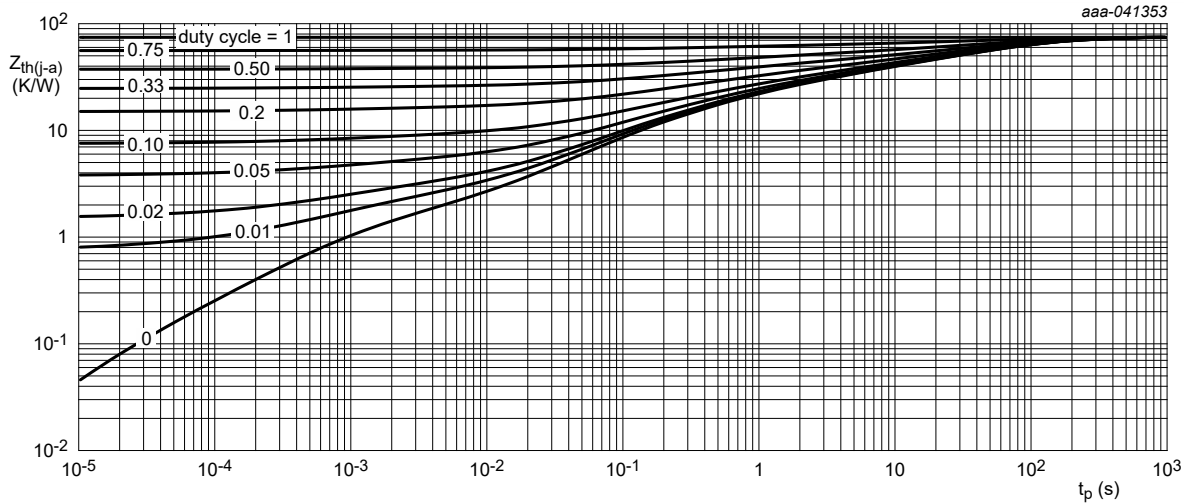
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air	[1]	-	-	208	K/W
			[2]	-	-	83	K/W
			[3]	-	-	86	K/W
			[4]	-	-	51	K/W
			[5]	-	-	50	K/W
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point			-	-	20	K/W

- [1] Device mounted on an FR4 PCB, single-sided, 35 μm copper, tin-plated and standard footprint.  
[2] Device mounted on an FR4 PCB, single-sided, 35 μm copper, tin-plated, mounting pad for collector 6 cm<sup>2</sup>.  
[3] Device mounted on an FR4 PCB, 4-layer, tin-plated and standard footprint.  
[4] Device mounted on an FR4 PCB, 4-layer, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.  
[5] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, single-sided, 35 μm copper, tin-plated and standard footprint.



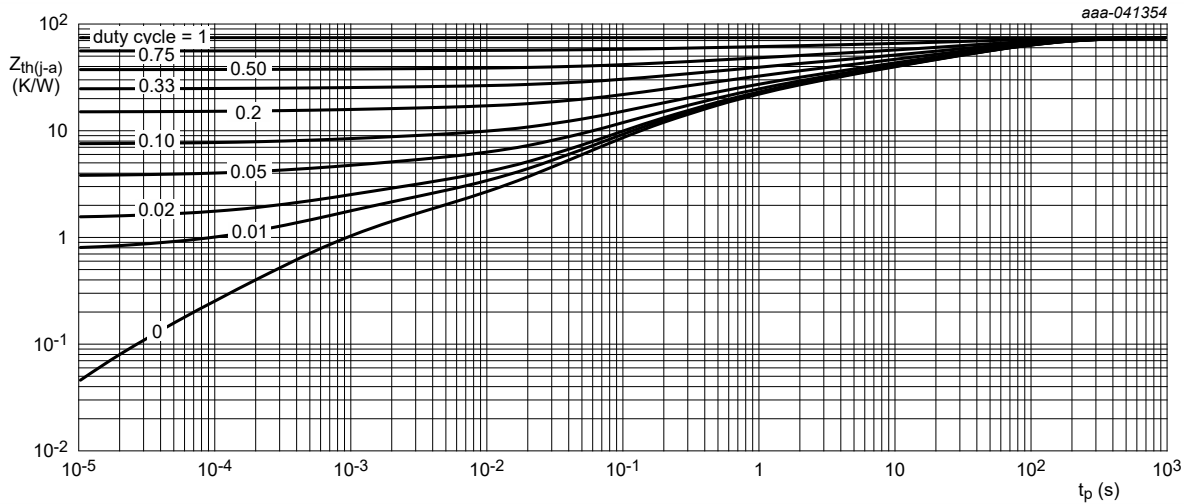
FR4 PCB, single-sided, 35  $\mu\text{m}$  copper, tin-plated and standard footprint

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



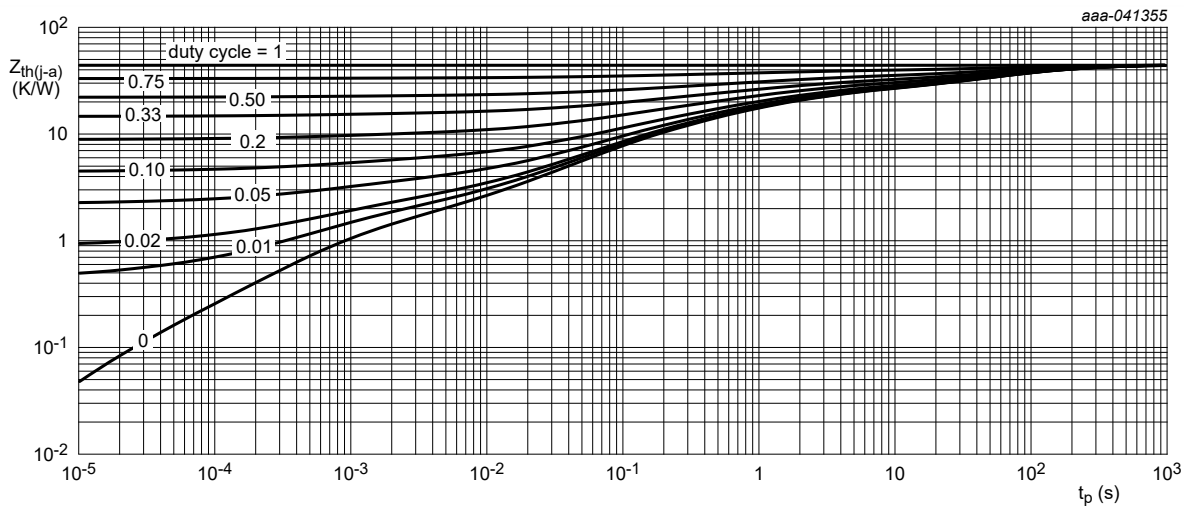
FR4 PCB, single-sided, 35  $\mu\text{m}$  copper, tin-plated, mounting pad for collector 6  $\text{cm}^2$ .

Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



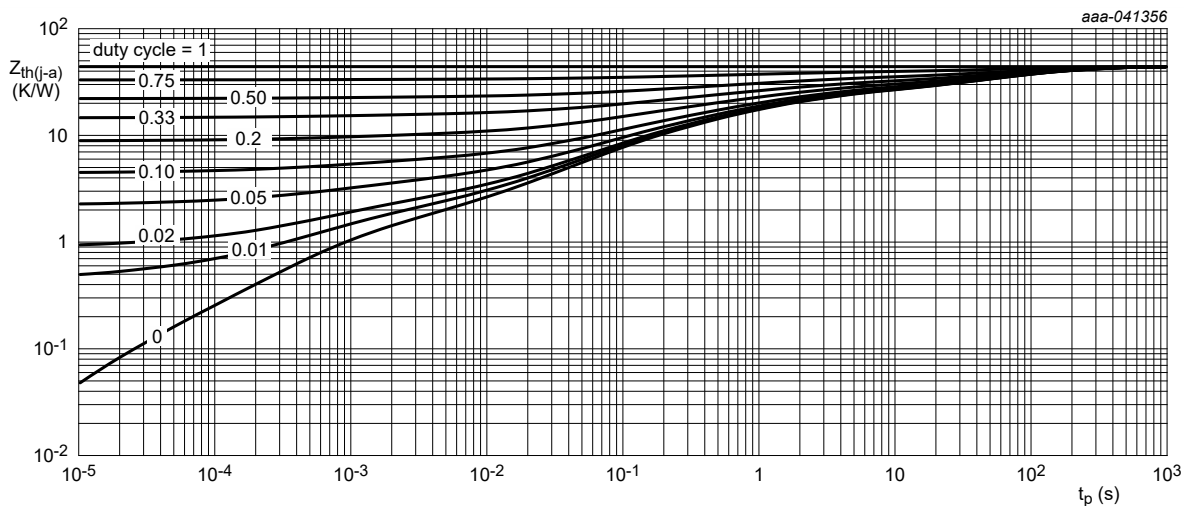
FR4 PCB, 4-layer 35  $\mu\text{m}$  copper, tin-plated and standard footprint.

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



FR4 PCB, 4-layer 35  $\mu$ m copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

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



Ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, single-sided, 35  $\mu$ m copper, tin-plated and standard footprint.

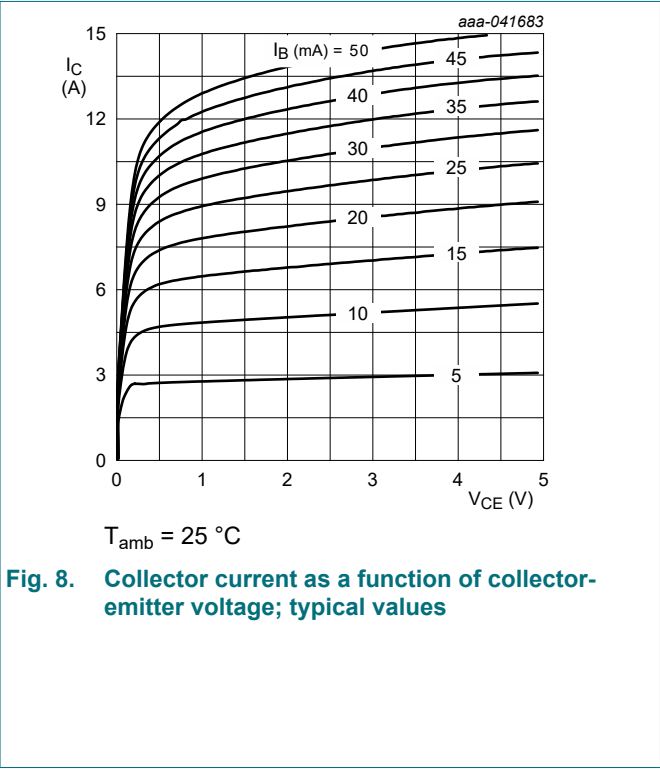
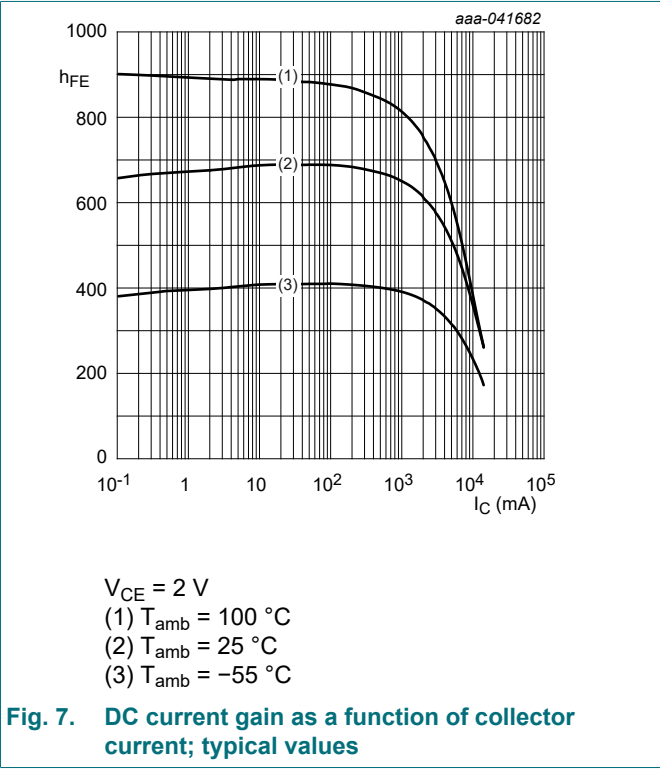
Fig. 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100\ \mu\text{A}$ ; $I_E = 0\ \text{A}$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	20	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 10\ \text{mA}$ ; $I_B = 0\ \text{A}$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	20	-	-	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 100\ \mu\text{A}$ ; $I_C = 0\ \text{A}$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	5	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 20\ \text{V}$ ; $I_E = 0\ \text{A}$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	-	100	nA
		$V_{CB} = 20\ \text{V}$ ; $I_E = 0\ \text{A}$ ; $T_J = 150\ ^\circ\text{C}$	-	-	50	$\mu\text{A}$
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = 16\ \text{V}$ ; $V_{BE} = 0\ \text{V}$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	-	100	nA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\ \text{V}$ ; $I_C = 0\ \text{A}$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	-	100	nA
$h_{FE}$	DC current gain	$V_{CE} = 2\ \text{V}$ ; $I_C = 0.5\ \text{A}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	300	620	-	
		$V_{CE} = 2\ \text{V}$ ; $I_C = 1\ \text{A}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	300	600	-	
		$V_{CE} = 2\ \text{V}$ ; $I_C = 2\ \text{A}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	300	570	-	
		$V_{CE} = 2\ \text{V}$ ; $I_C = 4\ \text{A}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	250	510	-	
		$V_{CE} = 2\ \text{V}$ ; $I_C = 8\ \text{A}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	100	400	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 1\ \text{A}$ ; $I_B = 10\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	30	60	mV
		$I_C = 1\ \text{A}$ ; $I_B = 50\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	20	38	mV
		$I_C = 2\ \text{A}$ ; $I_B = 40\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	40	75	mV
		$I_C = 4\ \text{A}$ ; $I_B = 40\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	80	140	mV
		$I_C = 4\ \text{A}$ ; $I_B = 200\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	65	120	mV
		$I_C = 7\ \text{A}$ ; $I_B = 350\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	110	210	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 5\ \text{A}$ ; $I_B = 500\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	15	28	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 1\ \text{A}$ ; $I_B = 100\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	0.85	0.9	V
		$I_C = 4\ \text{A}$ ; $I_B = 400\ \text{mA}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	0.99	1.05	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2\ \text{V}$ ; $I_C = 2\ \text{A}$ ; pulsed; $t_p \leq 300\ \mu\text{s}$ ; $\delta \leq 0.02$ ; $T_{\text{amb}} = 25\ ^\circ\text{C}$	-	0.76	0.85	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_d$	delay time	$V_{CC} = 12.5\text{ V}; I_C = 1\text{ A}; I_{B(on)} = 50\text{ mA};$ $I_{B(off)} = -50\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}$	-	40	-	ns
$t_r$	rise time		-	35	-	ns
$t_{on}$	turn-on time		-	75	-	ns
$t_s$	storage time		-	430	-	ns
$t_f$	fall time		-	65	-	ns
$t_{off}$	turn-off time		-	495	-	ns
$f_T$	transition frequency	$V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz};$ $T_{amb} = 25\text{ }^{\circ}\text{C}$	-	115	-	MHz
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz};$ $T_{amb} = 25\text{ }^{\circ}\text{C}$	-	70	-	pF



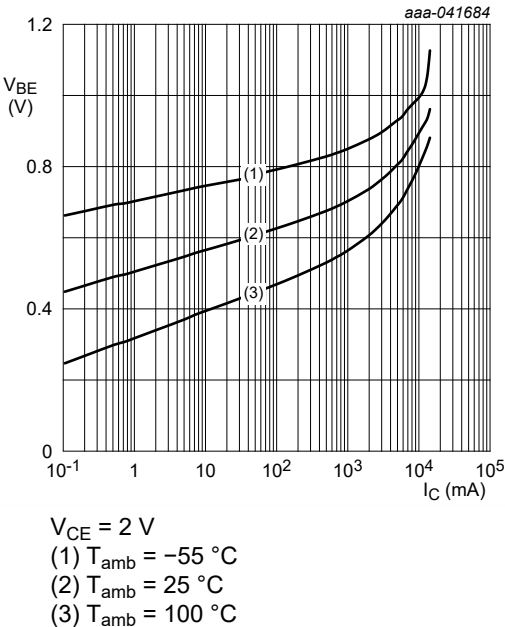


Fig. 9. Base-emitter voltage as a function of collector current; typical values

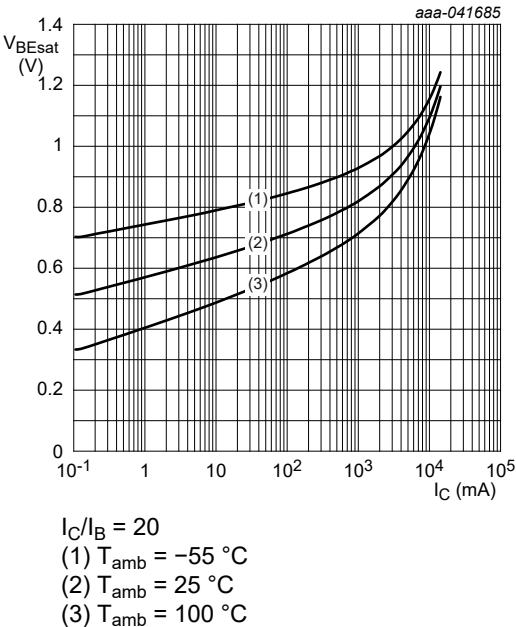


Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values

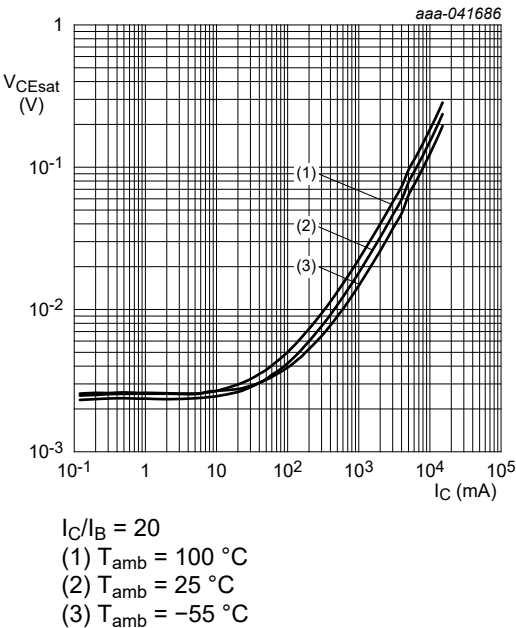


Fig. 11. Collector-emitter saturation voltage as a function of collector current; typical values

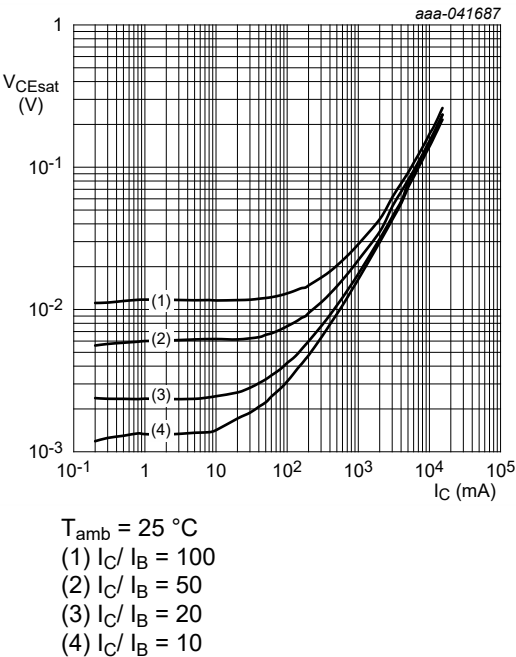


Fig. 12. Collector-emitter saturation voltage as a function of collector current; typical values



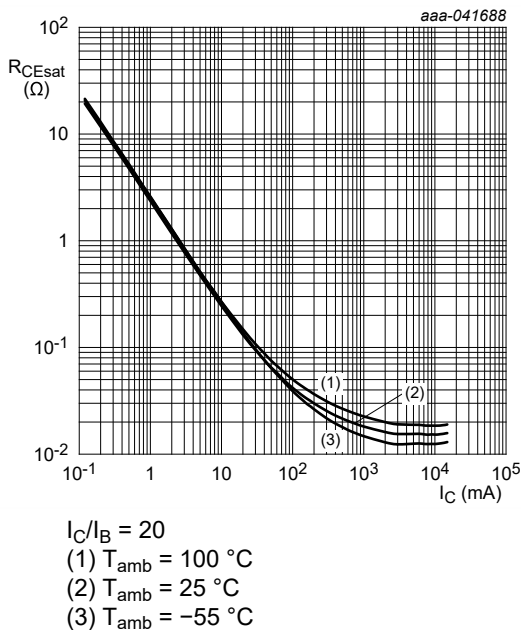


Fig. 13. Collector-emitter saturation resistance as a function of collector current; typical values

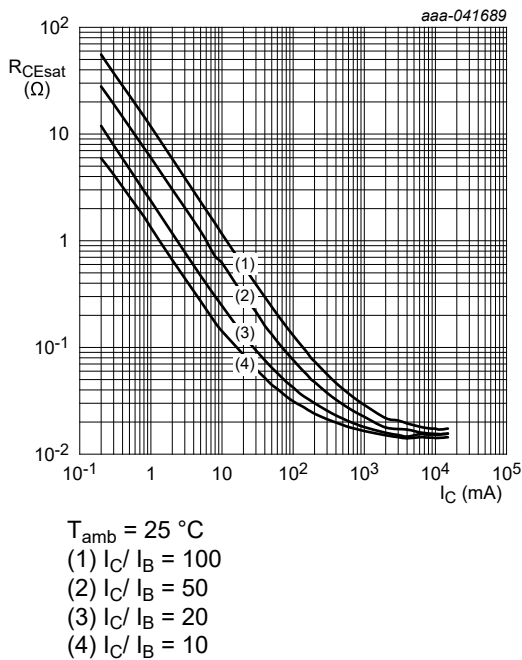


Fig. 14. Collector-emitter saturation resistance as a function of collector current; typical values

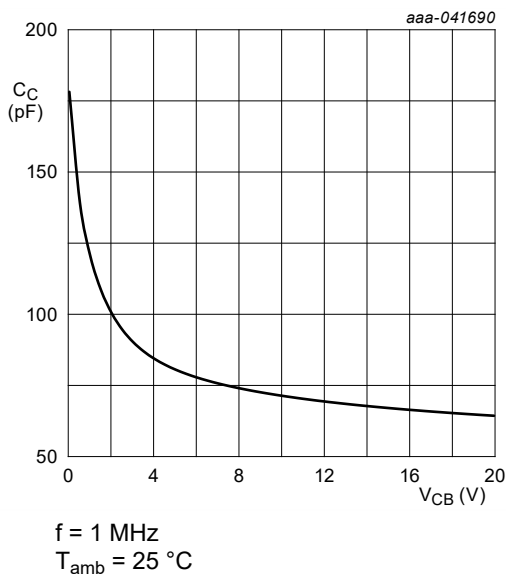


Fig. 15. Collector capacitance as a function of collector-base voltage; typical value

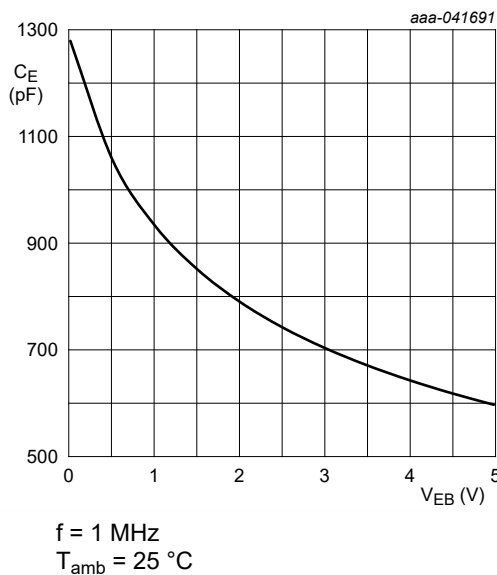


Fig. 16. Emitter capacitance as a function of emitter-base voltage; typical value

11. Test information

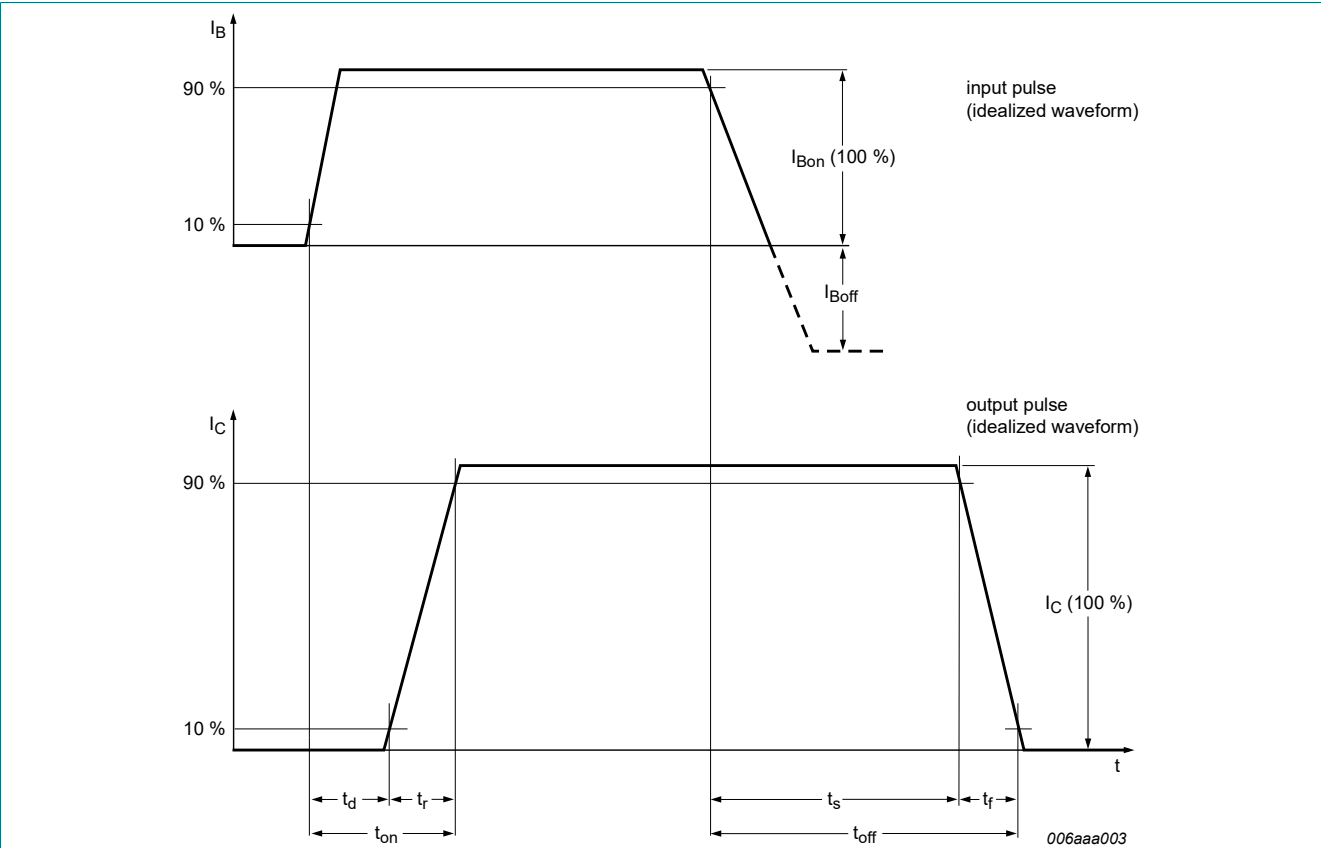


Fig. 17. Switching time definition

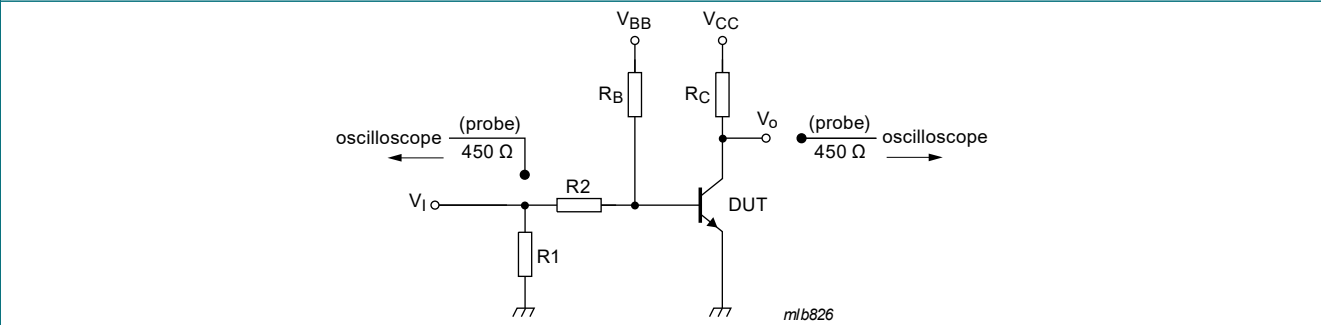
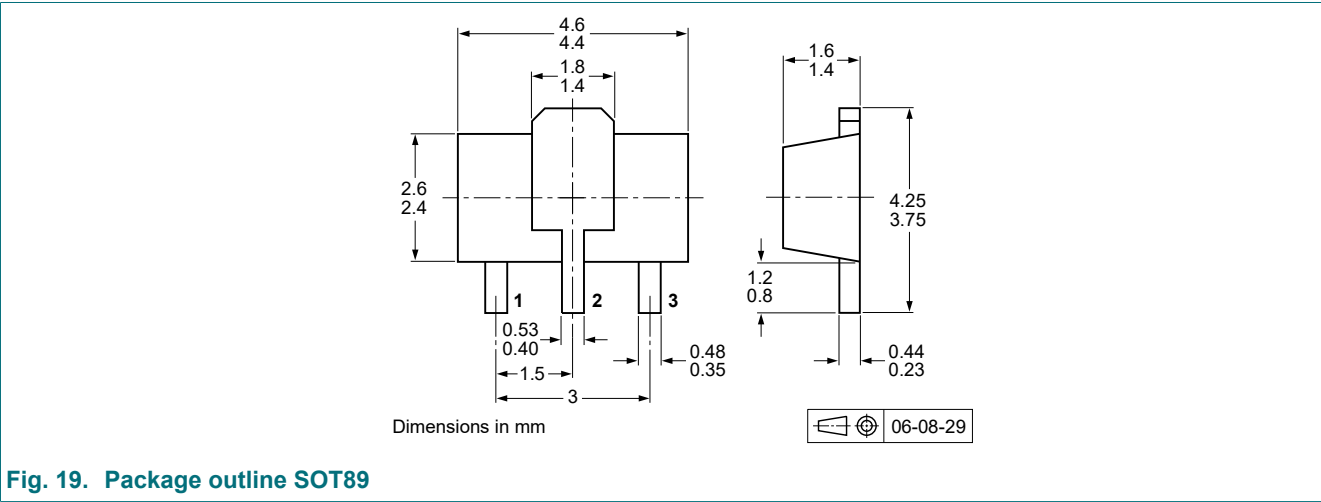


Fig. 18. Test circuit for switching times

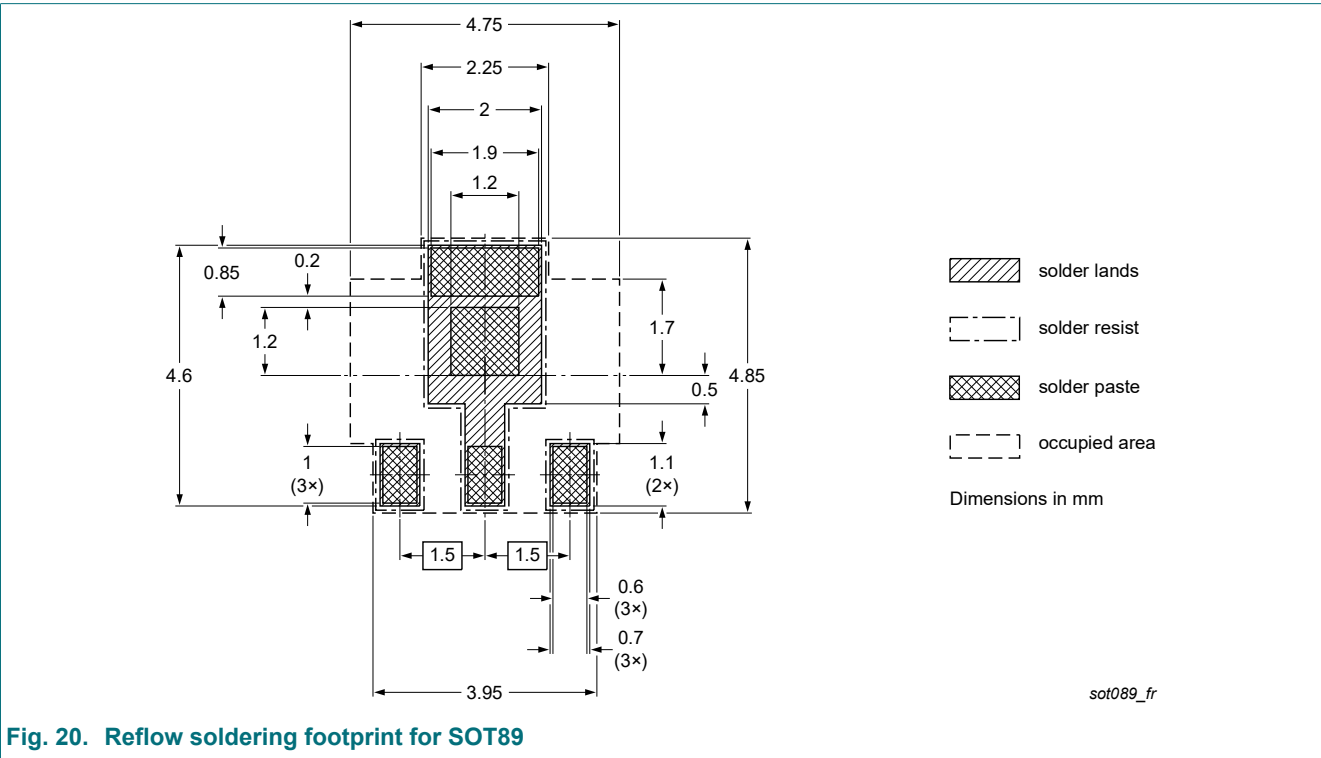
Quality information

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



13. Soldering





14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4021NX v.4	20250116	Product data sheet	-	PBSS4021NX v.3
Modifications:	<ul style="list-style-type: none"><li>Editorial update</li><li>New graphics and values are added.</li></ul>			
PBSS4021NX v.3	20121211	Product data sheet	-	PBSS4021NX v.2
PBSS4021NX v.2	20121009	Product data sheet	-	PBSS4021NX v.1
PBSS4021NX v.1	20100401	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.

- [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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Date of release: 16 January 2025