



# PBSS4360PAS

60 V, 3 A NPN low  $V_{CEsat}$  (BISS) transistor

16 October 2015

Product data sheet

## 1. General description

NPN low  $V_{CEsat}$  Breakthrough in a Small Signal (BISS) transistor, encapsulated in an ultra thin DFN2020D-3 (SOT1061D) leadless small Surface-Mounted Device (SMD) plastic package with medium power capability and visible and solderable side pads.

PNP complement: PBSS5360PAS

## 2. Features and benefits

- Low collector-emitter saturation voltage  $V_{CEsat}$
- High collector current capability  $I_C$  and  $I_{CM}$
- High collector current gain ( $h_{FE}$ ) at high  $I_C$
- 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
- AEC-Q101 qualified

## 3. Applications

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

## 4. Quick reference data

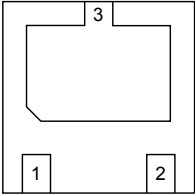
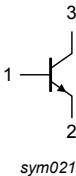
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	60	V
$I_C$	collector current		-	-	3	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	6	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 3$ A; $I_B = 300$ mA; pulsed; $t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C	-	73	108	m $\Omega$



5. Pinning information

Table 2. Pinning information

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

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PBSS4360PAS	DFN2020D-3	DFN2020D-3: plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals; body 2 x 2 x 0.65 mm	SOT1061D

7. Marking

Table 4. Marking codes

Type number	Marking code
PBSS4360PAS	E9

## 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		-	80	V
V <sub>CEO</sub>	collector-emitter voltage	open base		-	60	V
V <sub>EBO</sub>	emitter-base voltage	open collector		-	7	V
I <sub>C</sub>	collector current			-	3	A
I <sub>CM</sub>	peak collector current	single pulse; $t_p \leq 1$ ms		-	6	A
I <sub>B</sub>	base current			-	500	mA
I <sub>BM</sub>	peak base current			-	1	A
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	0.6	W
			[2][3]	-	1.2	W
			[4]	-	1.5	W
			[5][6]	-	2.5	W
T <sub>j</sub>	junction temperature			-	175	°C
T <sub>amb</sub>	ambient temperature			-55	175	°C
T <sub>stg</sub>	storage temperature			-65	175	°C

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

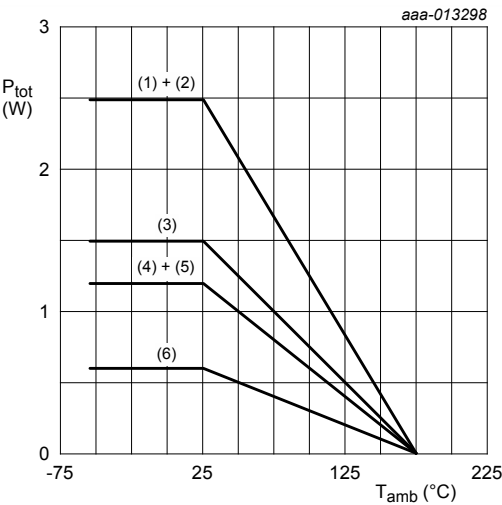
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

[3] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and standard footprint.

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

[5] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.

[6] Device mounted on an FR4 PCB, 4-layer copper, tin-plated and mounting pad for collector 1 cm<sup>2</sup>.



- (1) Ceramic PCB, single-sided copper, standard footprint
- (2) FR4 PCB, 4-layer copper, 1 cm<sup>2</sup>
- (3) FR4 PCB, single-sided copper, 6 cm<sup>2</sup>
- (4) FR4 PCB, single-sided copper, 1 cm<sup>2</sup>
- (5) FR4 PCB, 4-layer copper, standard footprint
- (6) FR4 PCB, single-sided copper, standard footprint

Fig. 1. Power derating curves

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]	-	-	250	K/W
			[2][3]	-	-	125	K/W
			[4]	-	-	100	K/W
			[5][6]	-	-	60	K/W

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

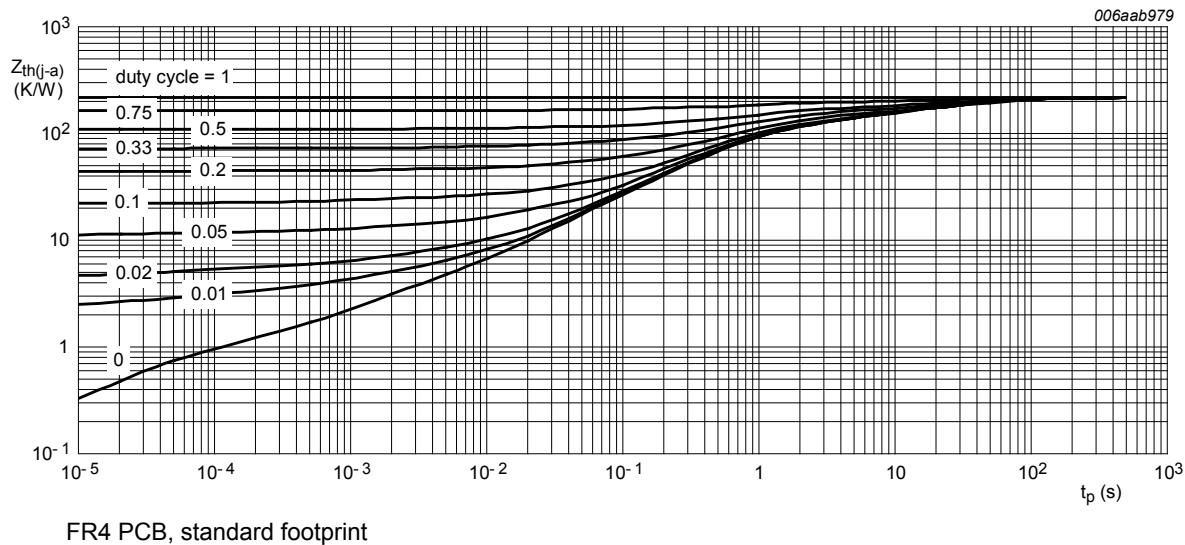


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

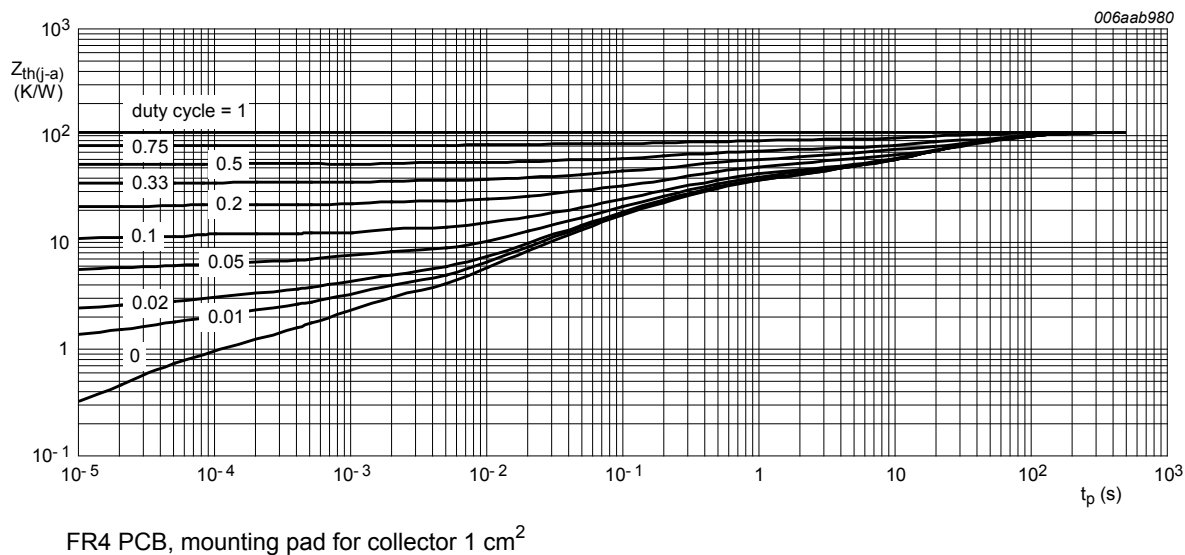
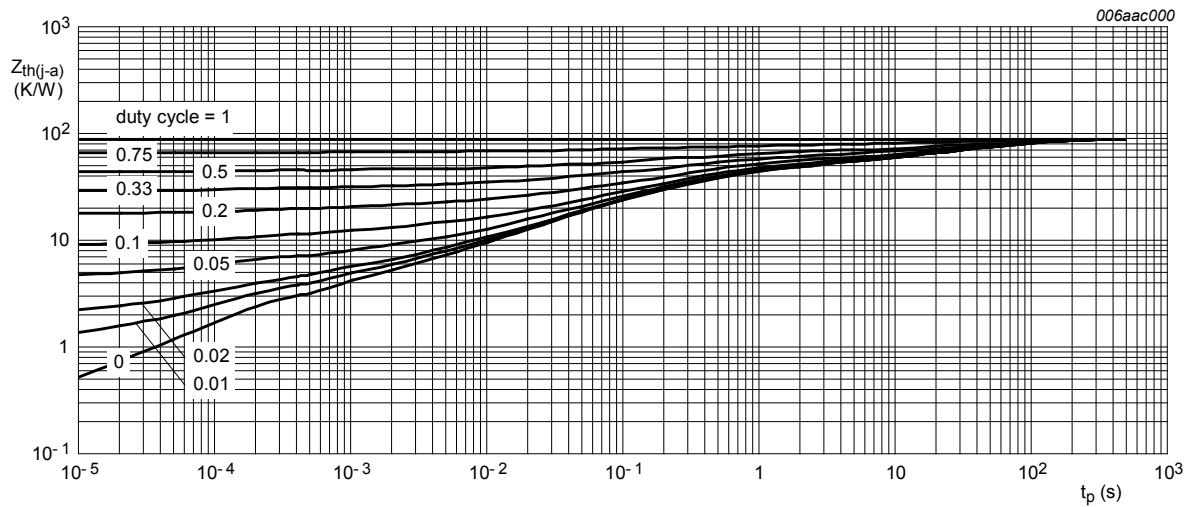
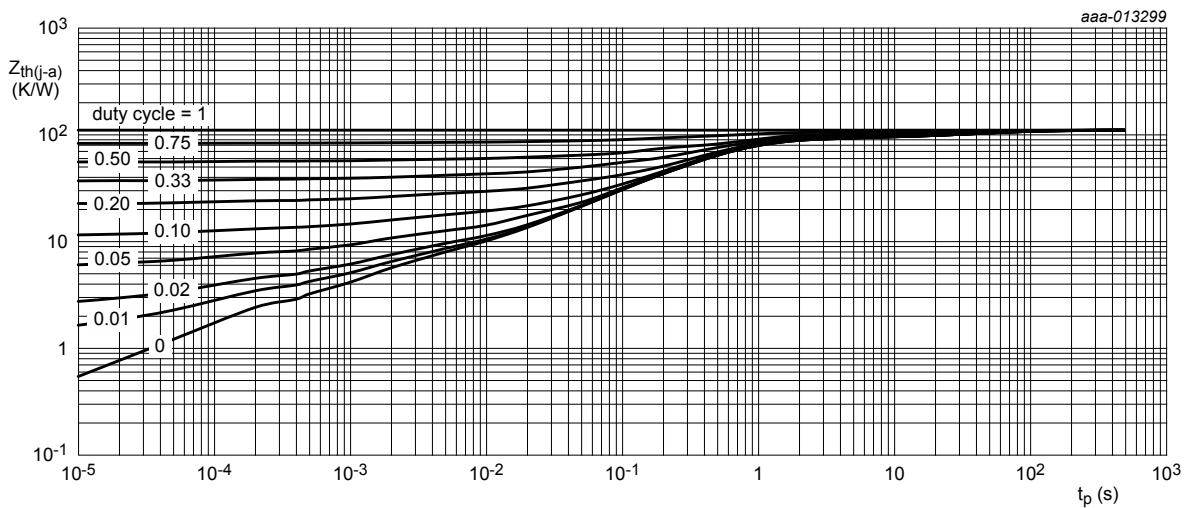


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



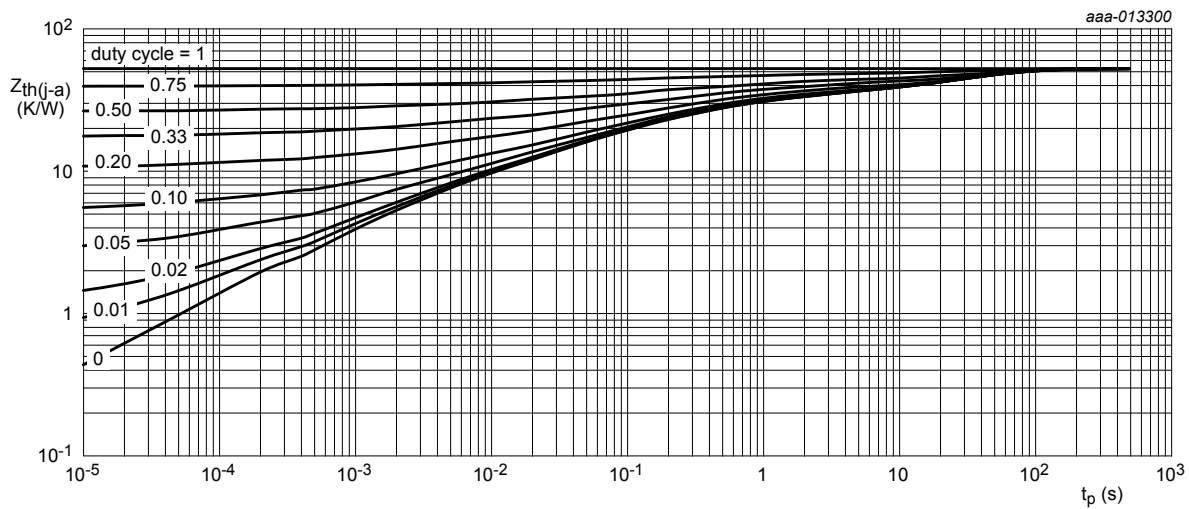
FR4 PCB, mounting pad for collector 6 cm<sup>2</sup>

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



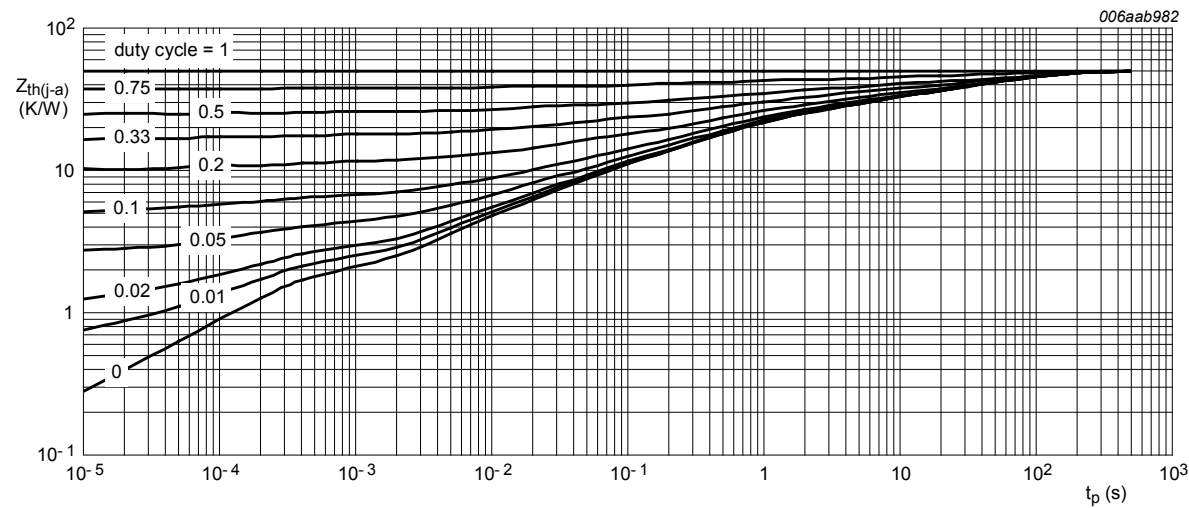
FR4 PCB, 4-layer copper, standard footprint

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



FR4 PCB, 4-layer copper, mounting pad for collector 1 cm<sup>2</sup>

Fig. 6. 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>, standard footprint

Fig. 7. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

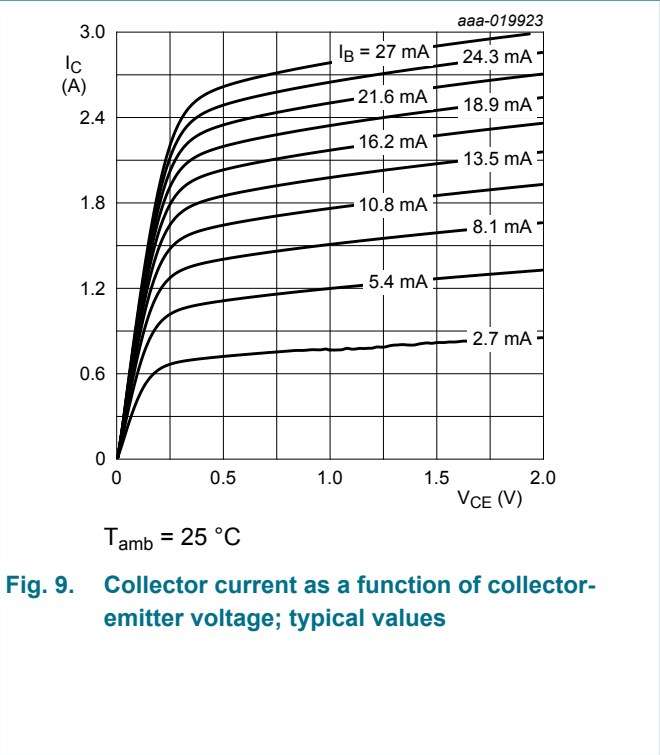
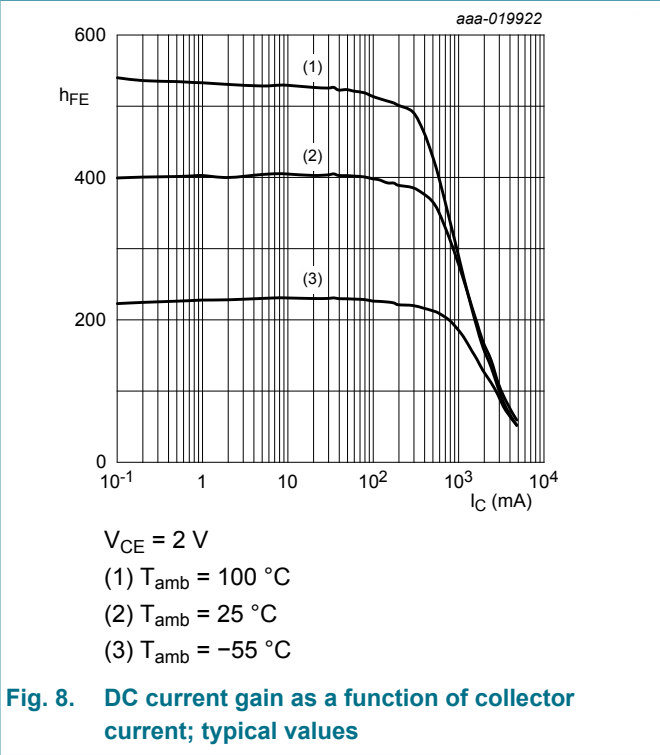
## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 64 \text{ V}; I_E = 0 \text{ A}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	-	100	nA
		$V_{CB} = 64 \text{ V}; I_E = 0 \text{ A}; T_j = 150 \text{ }^{\circ}\text{C}$	-	-	50	$\mu\text{A}$
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = 48 \text{ V}; V_{BE} = 0 \text{ V}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	-	100	nA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5.6 \text{ V}; I_C = 0 \text{ A}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	-	100	nA
$h_{FE}$	DC current gain	$V_{CE} = 5 \text{ V}; I_C = 0.05 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	200	380	-	
		$V_{CE} = 5 \text{ V}; I_C = 0.5 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	200	360	-	
		$V_{CE} = 5 \text{ V}; I_C = 1 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	200	330	-	
		$V_{CE} = 5 \text{ V}; I_C = 2 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	125	220	-	
		$V_{CE} = 5 \text{ V}; I_C = 3 \text{ A}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	75	140	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 0.5 \text{ A}; I_B = 50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	45	60	mV
		$I_C = 1 \text{ A}; I_B = 100 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	80	110	mV
		$I_C = 2 \text{ A}; I_B = 200 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	150	210	mV
		$I_C = 3 \text{ A}; I_B = 300 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	220	325	mV
$R_{CEsat}$	collector-emitter saturation resistance	$t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	73	108	m $\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 2 \text{ A}; I_B = 100 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	0.9	1.1	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 5 \text{ V}; I_C = 1 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ } \mu\text{s}; \delta \leq 0.02; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	0.75	0.95	V
$t_d$	delay time	$I_C = 2 \text{ A}; I_{B(on)} = 0.1 \text{ A}; I_{B(off)} = -0.1 \text{ A}; T_{amb} = 25 \text{ }^{\circ}\text{C}$	-	11	-	ns
$t_r$	rise time		-	130	-	ns
$t_{on}$	turn-on time		-	141	-	ns
$t_s$	storage time		-	200	-	ns
$t_f$	fall time		-	110	-	ns
$t_{off}$	turn-off time		-	310	-	ns



Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$f_T$	transition frequency	$V_{CE} = 10\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$	75	160	-	MHz
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A}; f = 1\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C}$	-	11	14	pF



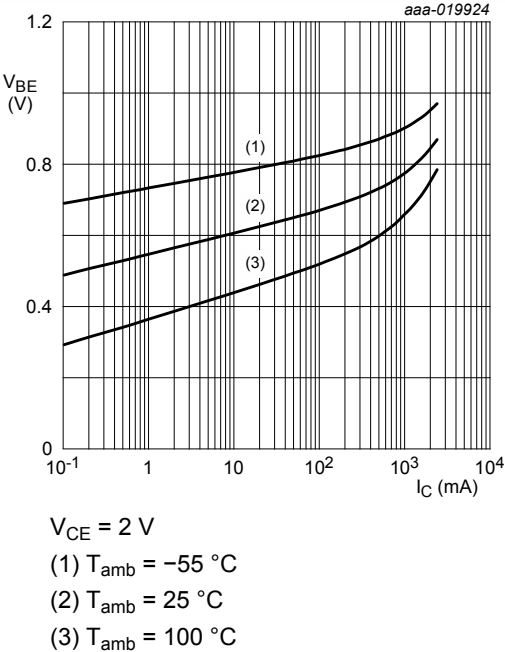


Fig. 10. Base-emitter voltage as a function of collector current; typical values

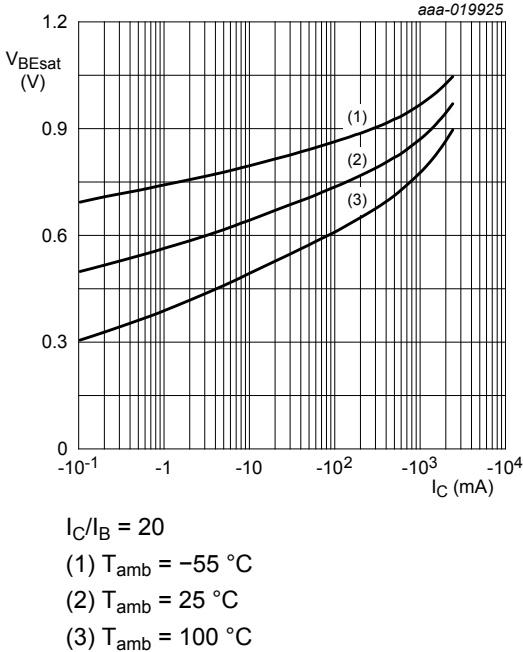


Fig. 11. Base-emitter saturation voltage as a function of collector current; typical values

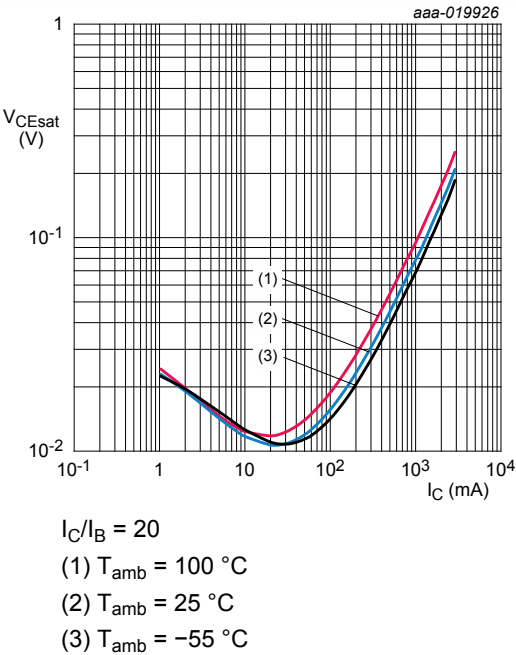


Fig. 12. Collector-emitter saturation voltage as a function of collector current; typical values

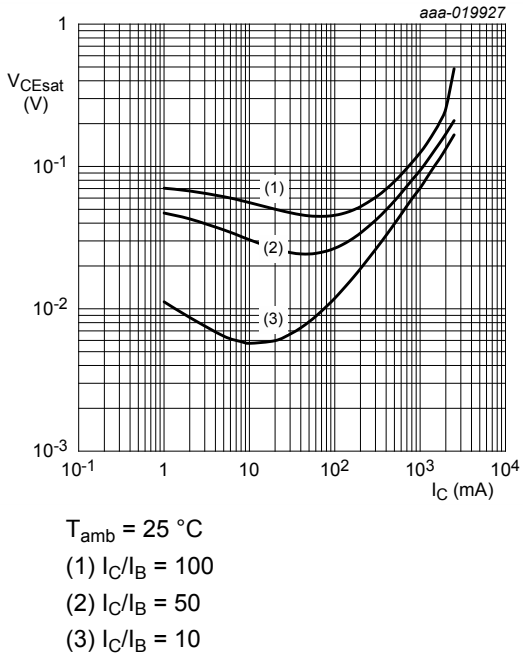


Fig. 13. Collector-emitter saturation voltage as a function of collector current; typical values

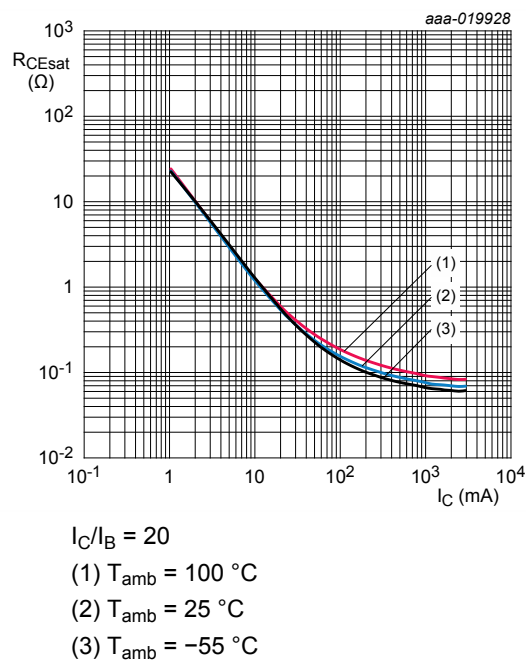


Fig. 14. Collector-emitter saturation resistance as a function of collector current; typical values

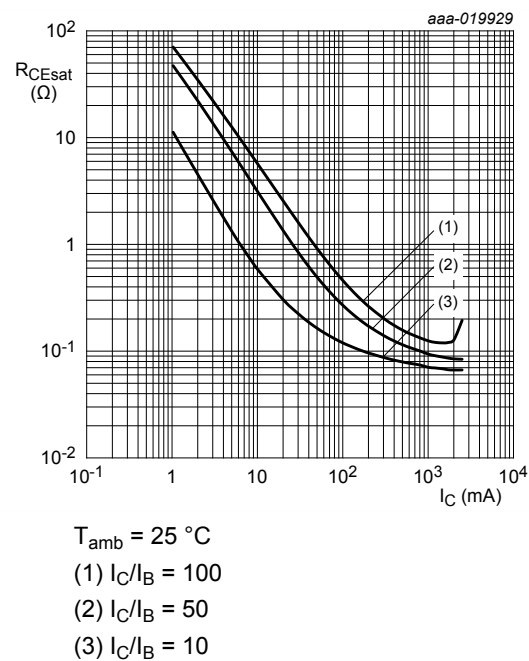


Fig. 15. Collector-emitter saturation resistance as a function of collector current; typical values

11. Test information

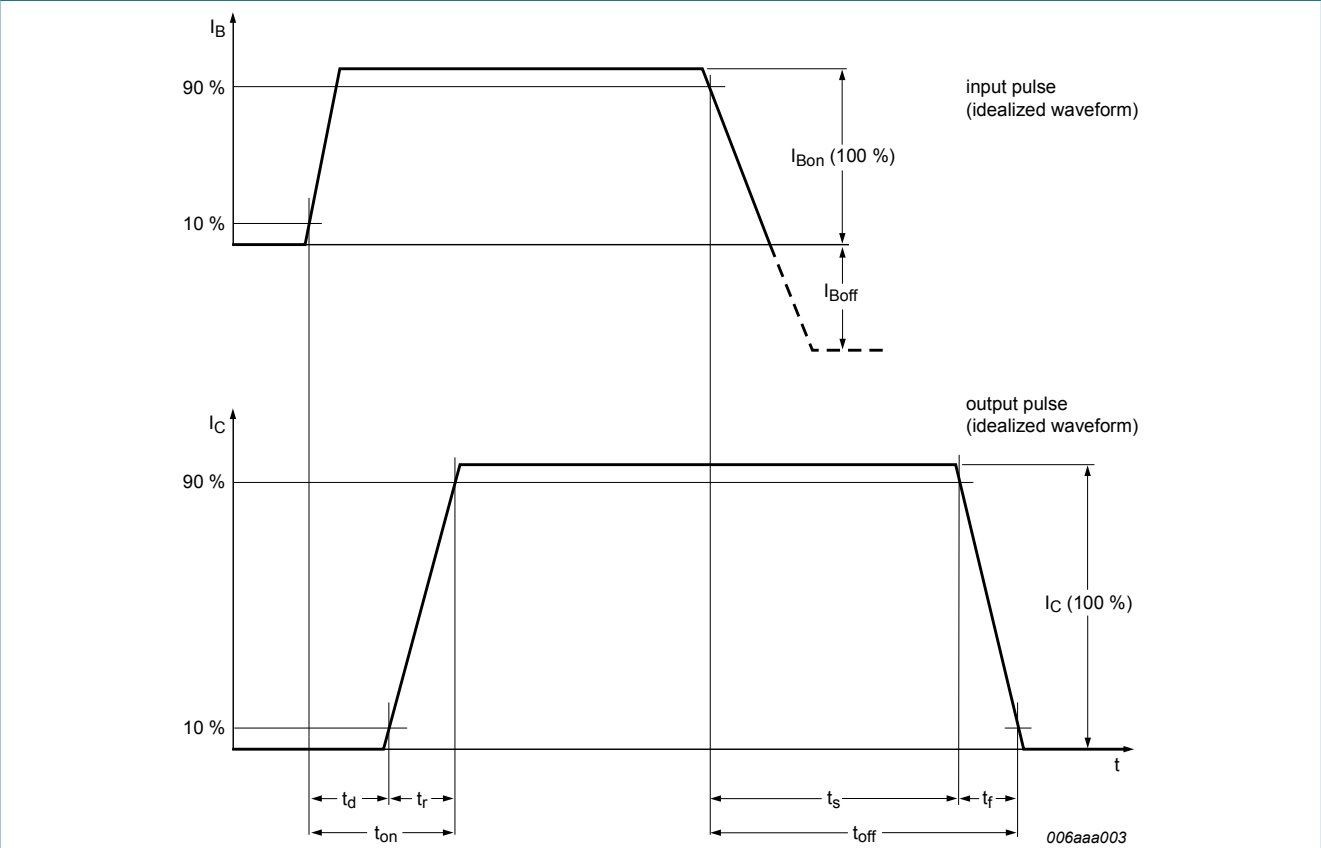


Fig. 16. BISS transistor switching time definition

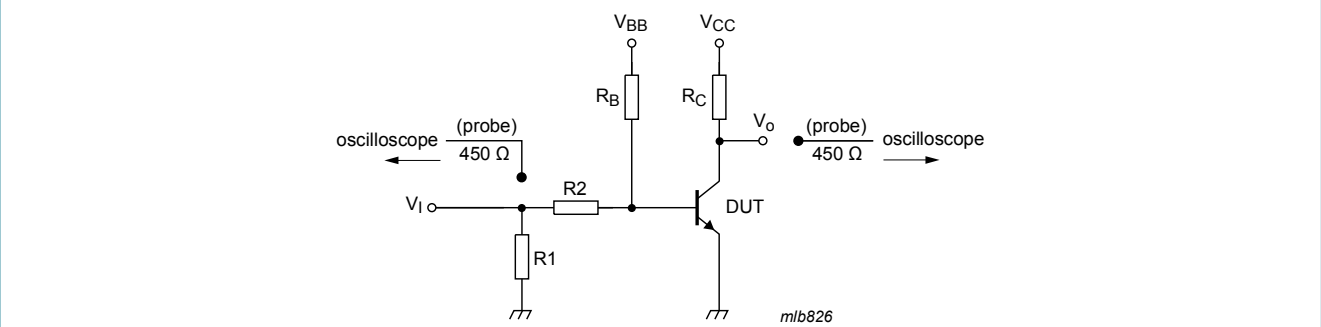


Fig. 17. Test circuit for switching times

11.1 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

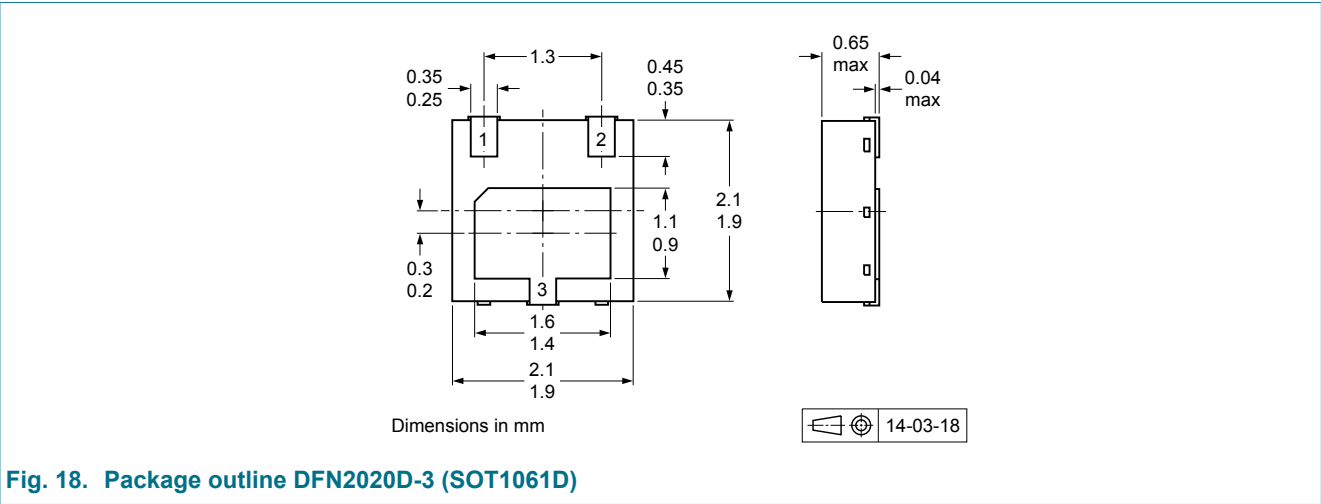
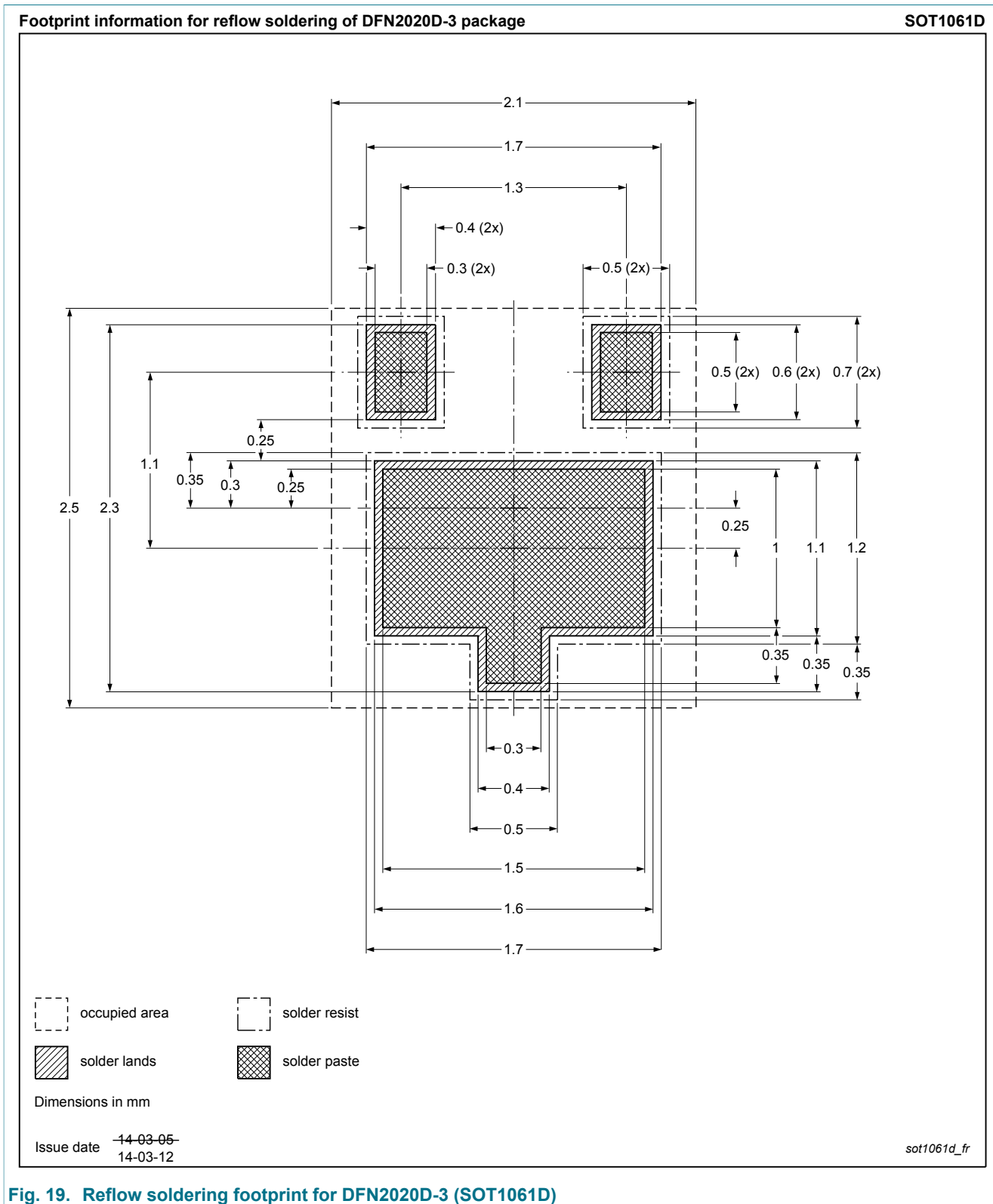


Fig. 18. Package outline DFN2020D-3 (SOT1061D)

## 13. Soldering



**Fig. 19. 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
PBSS4360PAS v.1	20151016	Product data sheet	-	-

## 15. Legal information

### 15.1 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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