



# PBSS4230QA

30 V, 2 A NPN low  $V_{CEsat}$  (BISS) transistor

23 August 2013

Product data sheet

## 1. General description

NPN low  $V_{CEsat}$  Breakthrough In Small Signal (BISS) transistor in a leadless ultra small DFN1010D-3 (SOT1215) Surface-Mounted Device (SMD) plastic package with visible and solderable side pads.

PNP complement: PBSS5230QA.

## 2. Features and benefits

- Very 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 energy efficiency due to less heat generation
- Reduced Printed-Circuit Board (PCB) area requirements
- Solderable side pads
- AEC-Q101 qualified

## 3. Applications

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

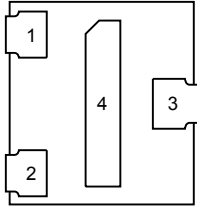
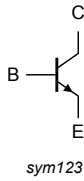
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CEO}$	collector-emitter voltage	open base	-	-	30	V
$I_C$	collector current		-	-	2	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms	-	-	3	A
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 1$ A; $I_B = 100$ mA; pulsed; $t_p \leq 300$ $\mu$ s; $\delta \leq 0.02$ ; $T_{amb} = 25$ °C	-	135	180	m $\Omega$

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>Transparent top view DFN1010D-3 (SOT1215)</p>	
2	E	emitter		
3	C	collector		
4	C	collector		

## 6. Ordering information

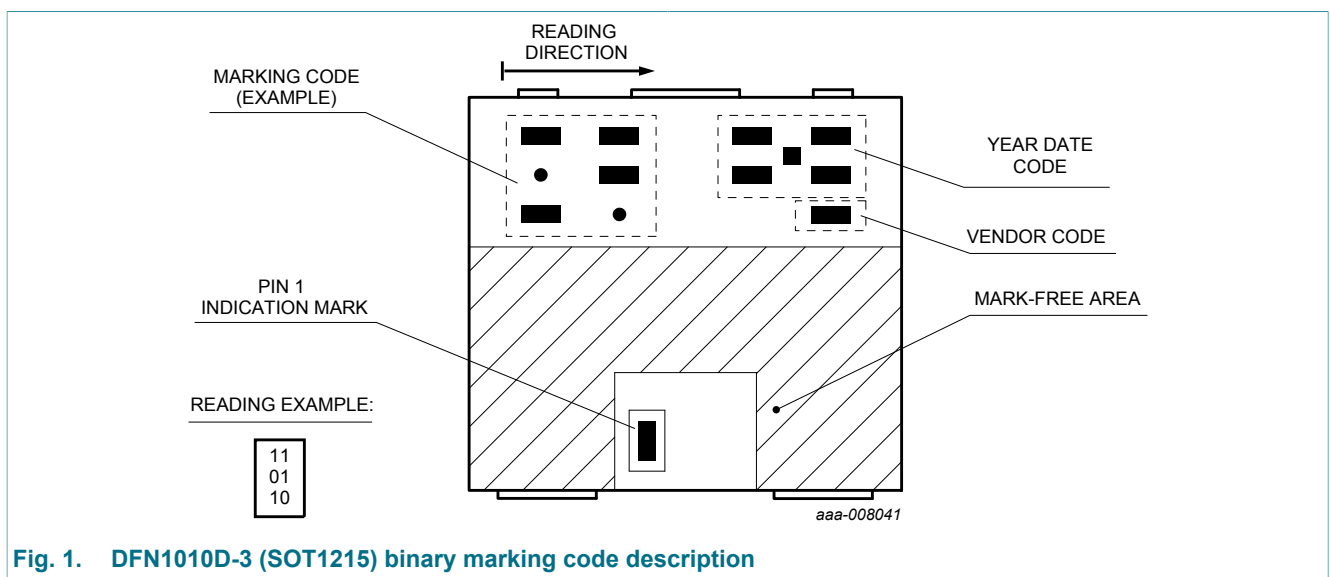
Table 3. Ordering information

Type number	Package		Version
	Name	Description	
PBSS4230QA	DFN1010D-3	plastic thermal enhanced ultra thin small outline package; no leads; 3 terminals	SOT1215

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PBSS4230QA	01 11 00



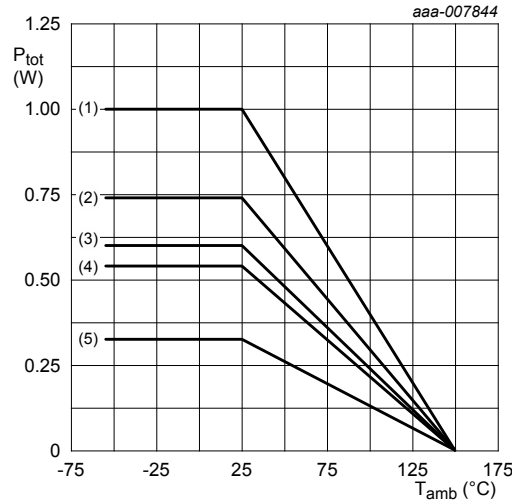
## 8. Limiting values

**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		-	30	V
$V_{CEO}$	collector-emitter voltage	open base		-	30	V
$V_{EBO}$	emitter-base voltage	open collector		-	7	V
$I_C$	collector current			-	2	A
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	3	A
$I_B$	base current			-	0.3	A
$I_{BM}$	peak base current	single pulse; $t_p \leq 1$ ms		-	1	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	325	mW
			[2]	-	600	mW
			[3]	-	740	mW
			[4]	-	540	mW
			[5]	-	1000	mW
$T_j$	junction temperature			-	150	°C
$T_{amb}$	ambient temperature			-55	150	°C
$T_{stg}$	storage temperature			-65	150	°C

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



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

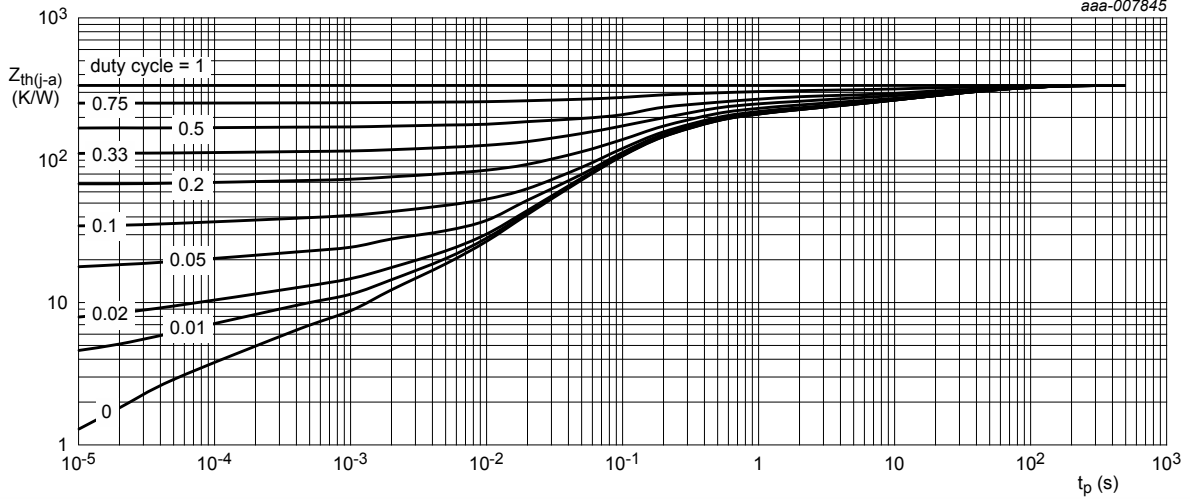
Fig. 2. Power derating curves

## 9. Thermal characteristics

Table 6. Thermal characteristics

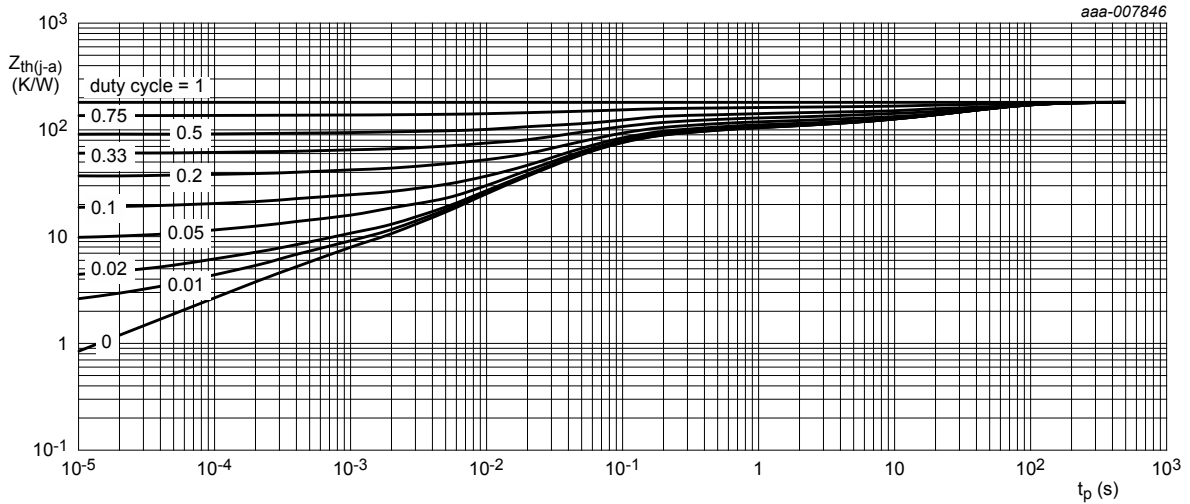
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air	[1]	-	-	385	K/W
			[2]	-	-	209	K/W
			[3]	-	-	169	K/W
			[4]	-	-	232	K/W
			[5]	-	-	125	K/W

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



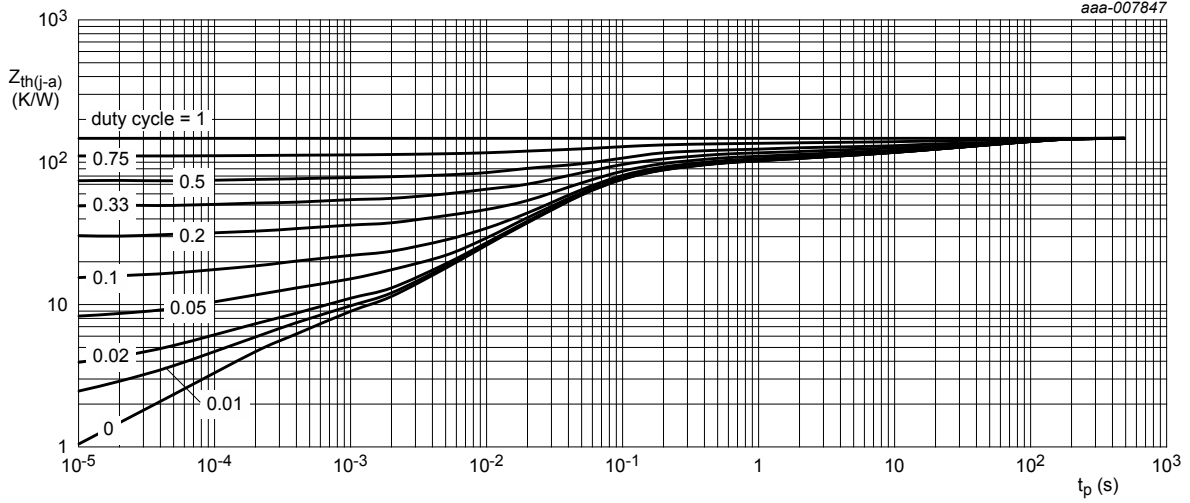
FR4 PCB, single-sided copper, standard footprint

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



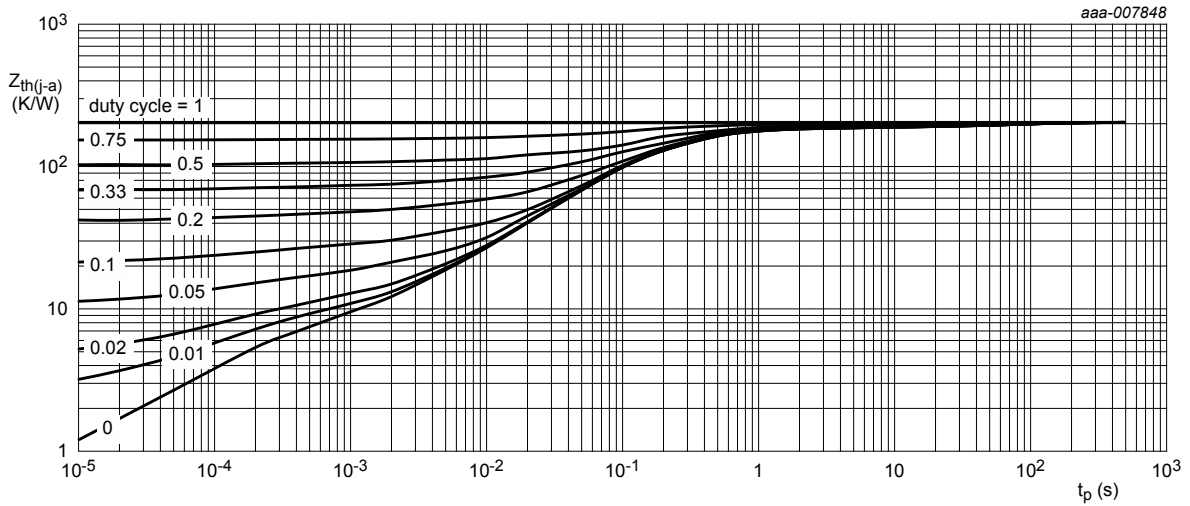
FR4 PCB, single-sided copper,  $1\text{ cm}^2$

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



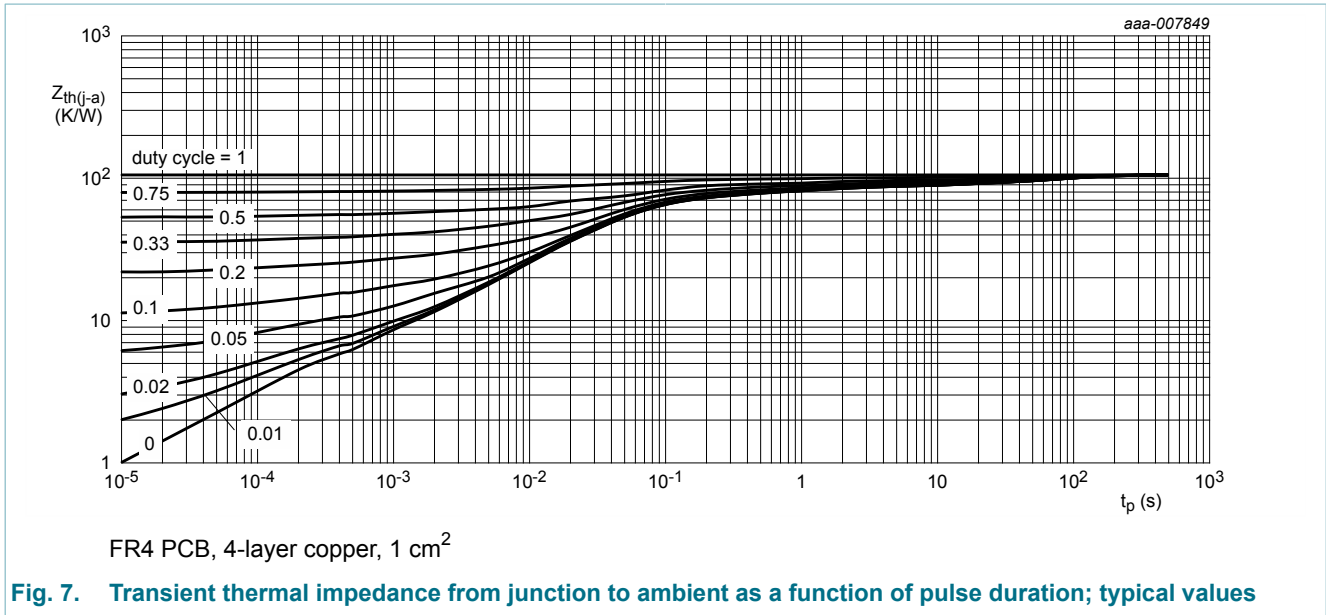
FR4 PCB, single-sided copper, 6 cm<sup>2</sup>

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



FR4 PCB, 4-layer copper, 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
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = 24 V; I <sub>E</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	100	nA
		V <sub>CB</sub> = 24 V; I <sub>E</sub> = 0 A; T <sub>j</sub> = 150 °C	-	-	50	μA
I <sub>CES</sub>	collector-emitter cut-off current	V <sub>CE</sub> = 24 V; V <sub>BE</sub> = 0 V; T <sub>amb</sub> = 25 °C	-	-	100	nA
I <sub>EBO</sub>	emitter-base cut-off current	V <sub>EB</sub> = 5 V; I <sub>C</sub> = 0 A; T <sub>amb</sub> = 25 °C	-	-	100	nA
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	250	430	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 500 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	230	380	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 1 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	180	290	-	
		V <sub>CE</sub> = 2 V; I <sub>C</sub> = 2 A; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	100	160	-	
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = 500 mA; I <sub>B</sub> = 50 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	75	100	mV
		I <sub>C</sub> = 1 A; I <sub>B</sub> = 50 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	140	190	mV
		I <sub>C</sub> = 1 A; I <sub>B</sub> = 100 mA; pulsed; t <sub>p</sub> ≤ 300 μs; δ ≤ 0.02; T <sub>amb</sub> = 25 °C	-	135	180	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$I_C = 2\text{ A}; I_B = 100\text{ mA};$ pulsed; $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	265	360	mV
		$I_C = 2\text{ A}; I_B = 200\text{ mA};$ pulsed; $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	255	350	mV
$R_{\text{CEsat}}$	collector-emitter saturation resistance	$I_C = 1\text{ A}; I_B = 100\text{ mA};$ pulsed; $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	135	180	m $\Omega$
$V_{\text{BEsat}}$	base-emitter saturation voltage	$I_C = 500\text{ mA}; I_B = 50\text{ mA};$ pulsed; $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	0.86	1	V
		$I_C = 1\text{ A}; I_B = 50\text{ mA};$ pulsed; $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	0.9	1.05	V
		$I_C = 2\text{ A}; I_B = 100\text{ mA};$ pulsed; $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	1	1.15	V
		$I_C = 2\text{ A}; I_B = 200\text{ mA};$ pulsed; $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	1.05	1.2	V
$V_{\text{BEon}}$	base-emitter turn-on voltage	$V_{\text{CE}} = 2\text{ V}; I_C = 0.5\text{ A};$ pulsed; $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	0.75	0.9	V
$t_d$	delay time	$V_{\text{CC}} = 10\text{ V}; I_C = 0.5\text{ A}; I_{\text{Bon}} = 25\text{ mA};$ $I_{\text{Boff}} = -25\text{ mA}; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	15	-	ns
$t_r$	rise time		-	30	-	ns
$t_{\text{on}}$	turn-on time		-	45	-	ns
$t_s$	storage time		-	425	-	ns
$t_f$	fall time		-	65	-	ns
$t_{\text{off}}$	turn-off time		-	490	-	ns
$f_T$	transition frequency	$V_{\text{CE}} = 10\text{ V}; I_C = 50\text{ mA}; f = 100\text{ MHz};$ $T_{\text{amb}} = 25\text{ }^\circ\text{C}$	130	190	-	MHz
$C_c$	collector capacitance	$V_{\text{CB}} = 10\text{ V}; I_E = 0\text{ A}; i_e = 0\text{ A};$ $f = 1\text{ MHz}; T_{\text{amb}} = 25\text{ }^\circ\text{C}$	-	8	10	pF



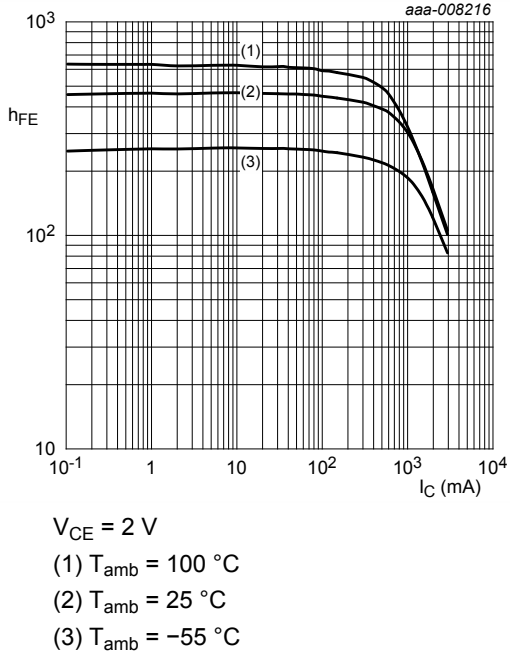


Fig. 8. DC current gain as a function of collector current; typical values

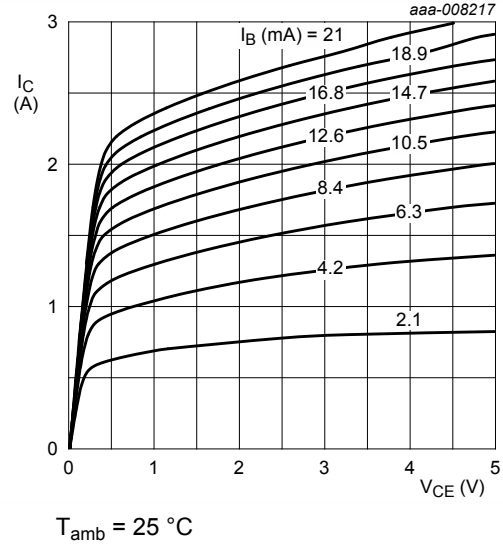


Fig. 9. Collector current as a function of collector-emitter voltage; typical values

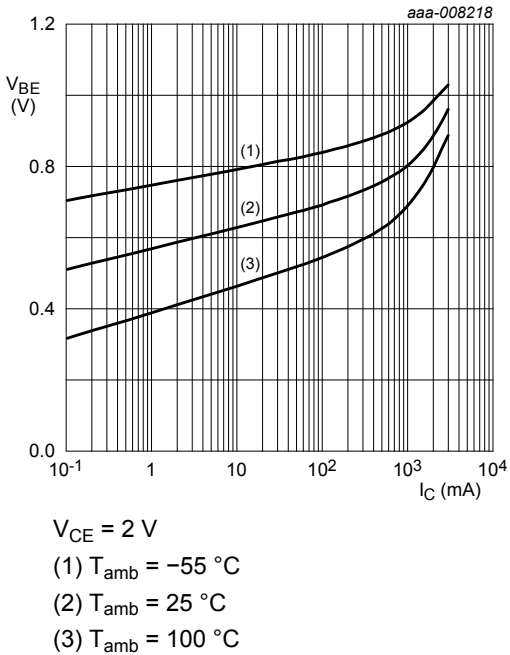


Fig. 10. Base-emitter voltage as a function of collector current; typical values

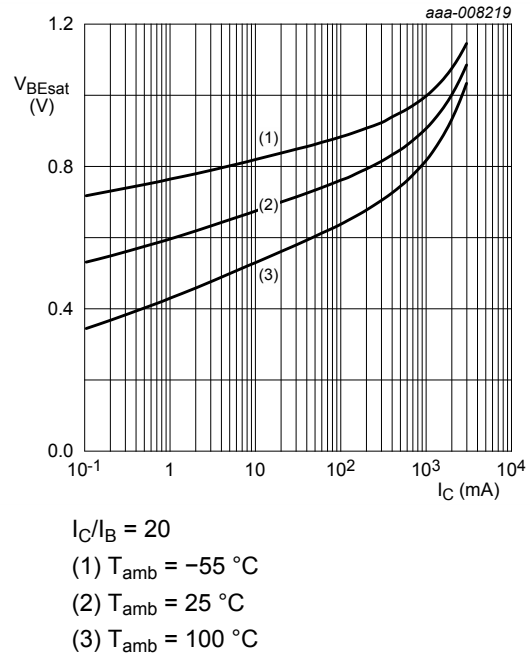
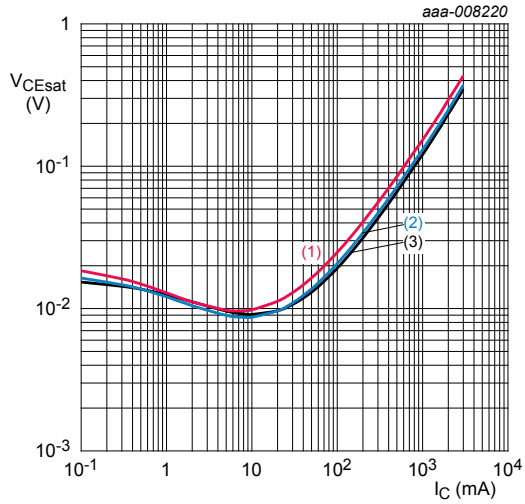
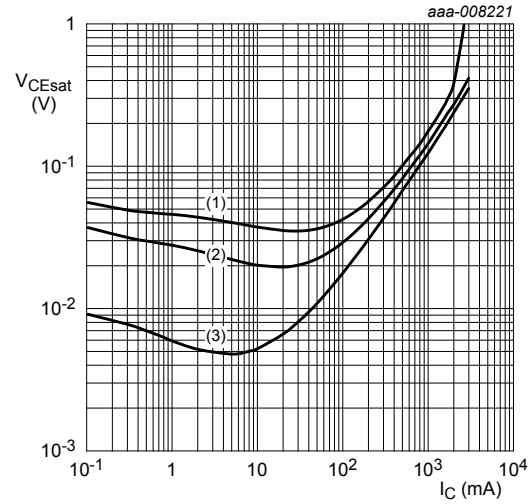


Fig. 11. Base-emitter saturation voltage as a function of collector current; typical values



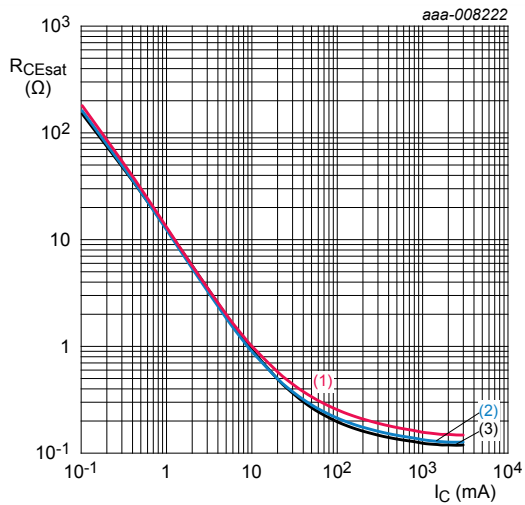
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

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



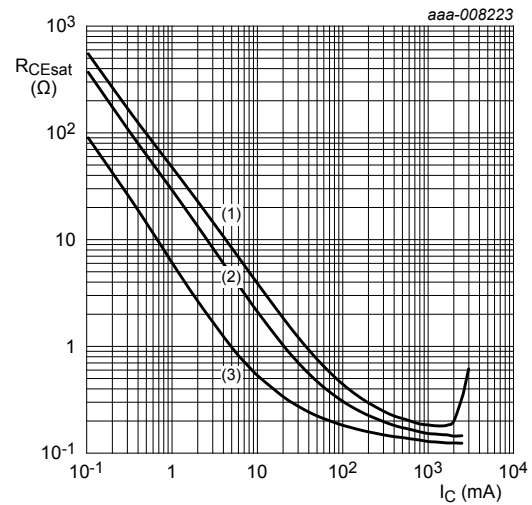
$T_{amb} = 25\text{ °C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

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



$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -55\text{ °C}$

**Fig. 14. 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)  $I_C/I_B = 10$

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

### 11. Test information

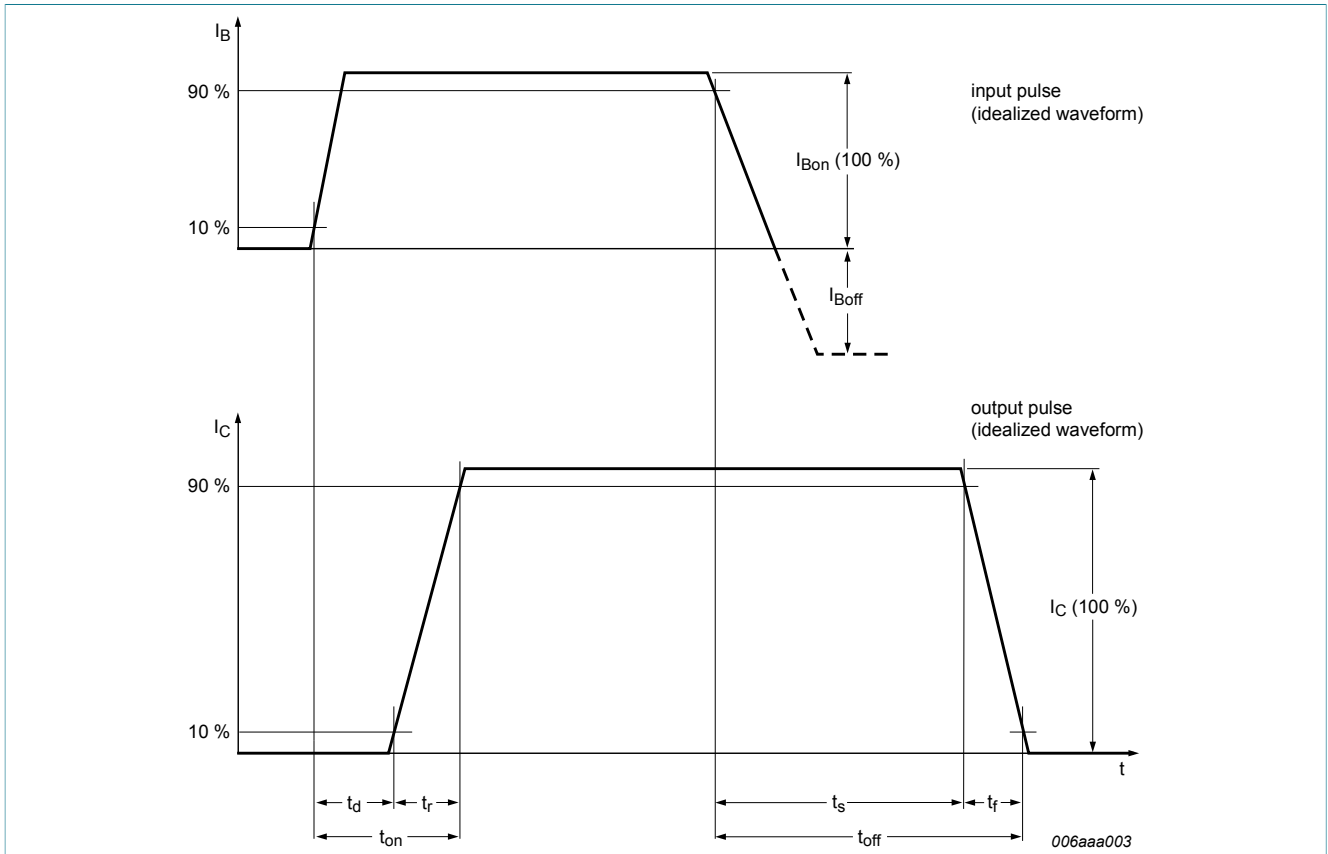


Fig. 16. BISS transistor switching time definition

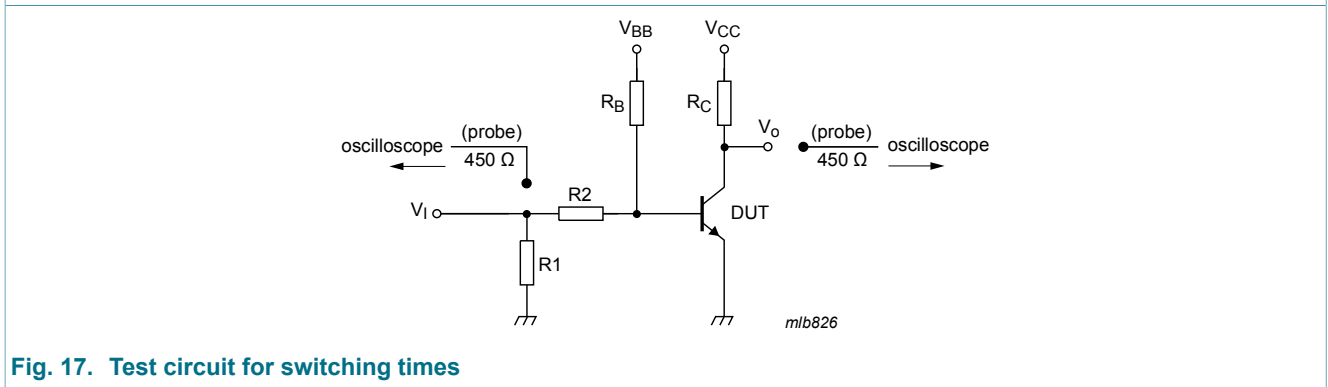
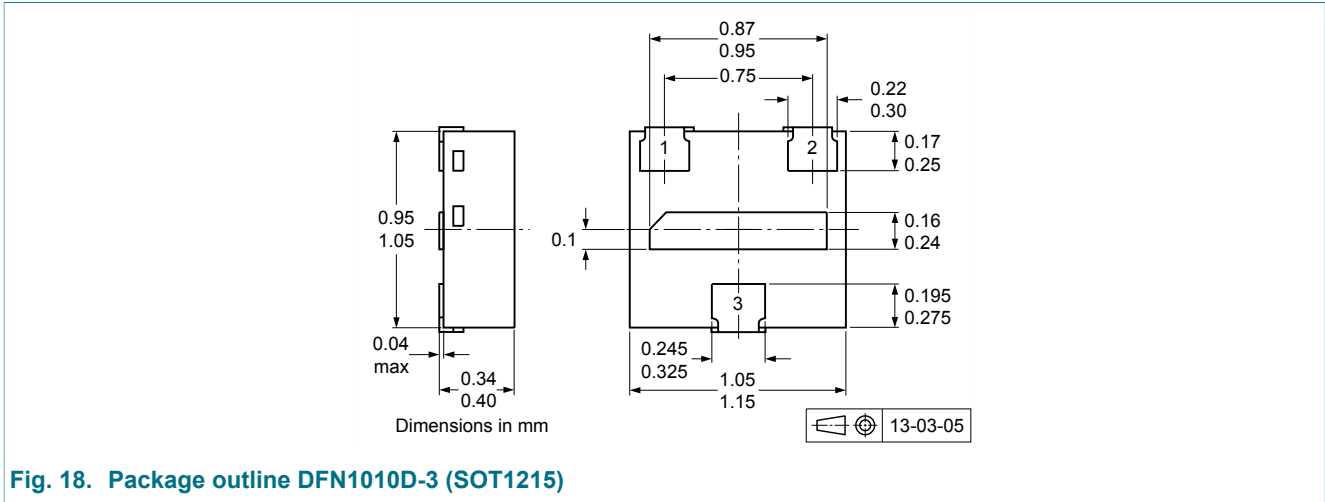


Fig. 17. Test circuit for switching times

#### 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 DFN1010D-3 (SOT1215)**

### 13. Soldering

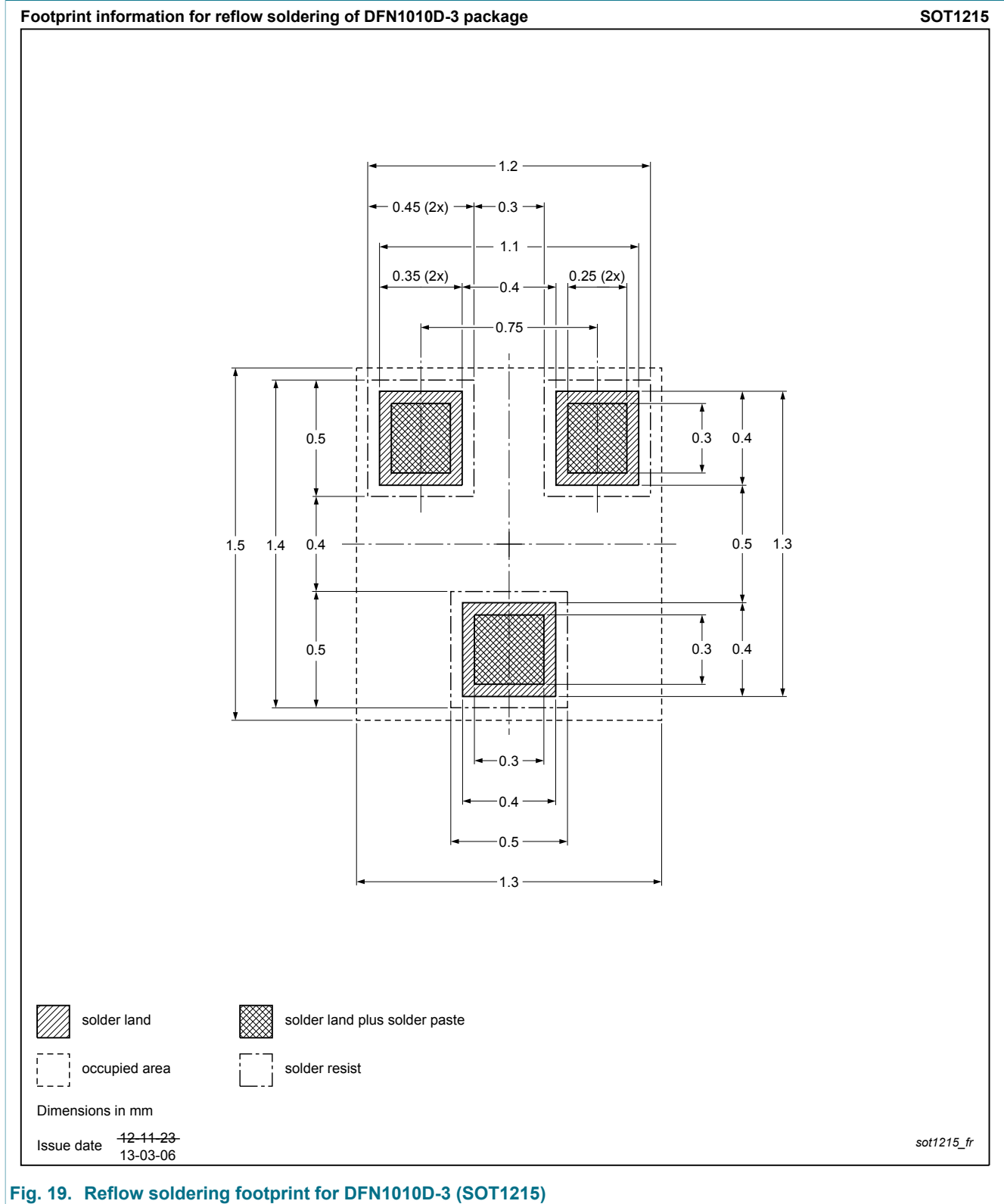


Fig. 19. Reflow soldering footprint for DFN1010D-3 (SOT1215)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PBSS4230QA v.1	20130823	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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Date of release: 23 August 2013