



# NHUMB10/13/9 series

80 V, 100 mA PNP/PNP resistor-equipped double transistors

Rev. 1 — 23 July 2020

Product data sheet

## 1. General description

PNP/PNP Resistor-Equipped double Transistor (RET) family in a very small SOT363 (SC-88) Surface-Mounted Device (SMD) plastic package.

Table 1. Product overview

Type number	R1	R2	Package		NPN/NPN complement:	NPN/PNP complement:
	k $\Omega$	k $\Omega$	Nexperia	JEITA		
NHUMB10	2.2	47	SOT363	SC-88	NHUMH10	NHUMD10
NHUMB13	4.7	47			NHUMH13	NHUMD13
NHUMB9	10	47			NHUMH9	NHUMD9

## 2. Features and benefits

- 100 mA output current capability
- High breakdown voltage
- Built-in resistors
- Simplifies circuit design
- Reduces component count
- Reduces pick and place costs
- AEC-Q101 qualified

## 3. Applications

- Digital applications
- Cost saving alternative for BC856 series in digital applications
- Controlling IC inputs
- Switching loads

## 4. Quick reference data

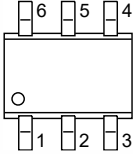
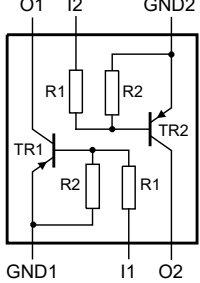
Table 2. Quick reference data

$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$V_{CEO}$	collector-emitter voltage	open base	-	-	-80	V
$I_O$	output current		-	-	-100	mA

## 5. Pinning information

Table 3. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	GND1	GND (emitter) TR1		
2	I1	input (base) TR1		
3	O2	output (collector) TR2		
4	GND2	GND (emitter) TR2		
5	I2	input (base) TR2		
6	O1	output (collector) TR1		

## 6. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
NHUMB10	SC-88	plastic surface-mounted package; 6 leads	SOT363
NHUMB13			
NHUMB9			

## 7. Marking

Table 5. Marking

Type number	Marking code [1]
NHUMB10	6B%
NHUMB13	6D%
NHUMB9	6A%

[1] % = placeholder for manufacturing site code

## 8. Limiting values

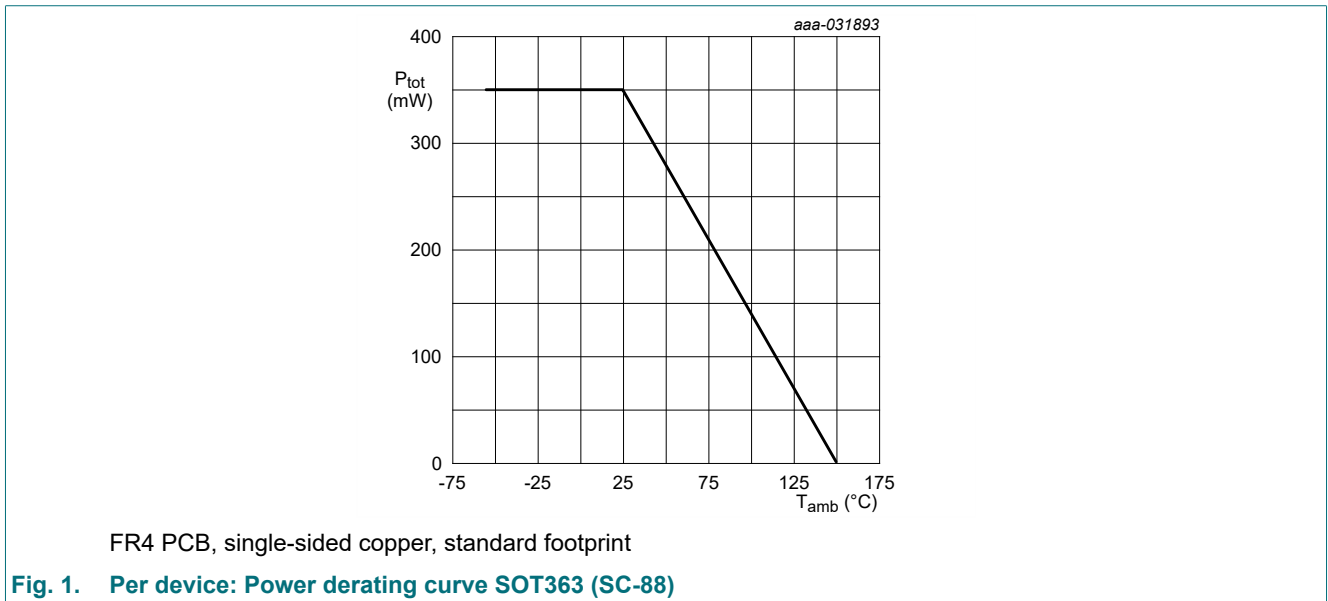
**Table 6. Limiting values**

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

$T_{amb} = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Max	Unit
<b>Per transistor</b>					
$V_{CBO}$	collector-base voltage	open emitter	-	-80	V
$V_{CEO}$	collector-emitter voltage	open base	-	-80	V
$V_{EBO}$	emitter-base voltage	open collector	-	-7	V
$V_I$	input voltage				
	NHUMB10		-20	+7	V
	NHUMB13		-30	+7	V
	NHUMB9		-40	+7	V
$I_O$	output current		-	-100	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	235	mW
<b>Per device</b>					
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	350	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 Printed-Circuit-Board (PCB); single-sided copper; tin-plated and standard footprint.



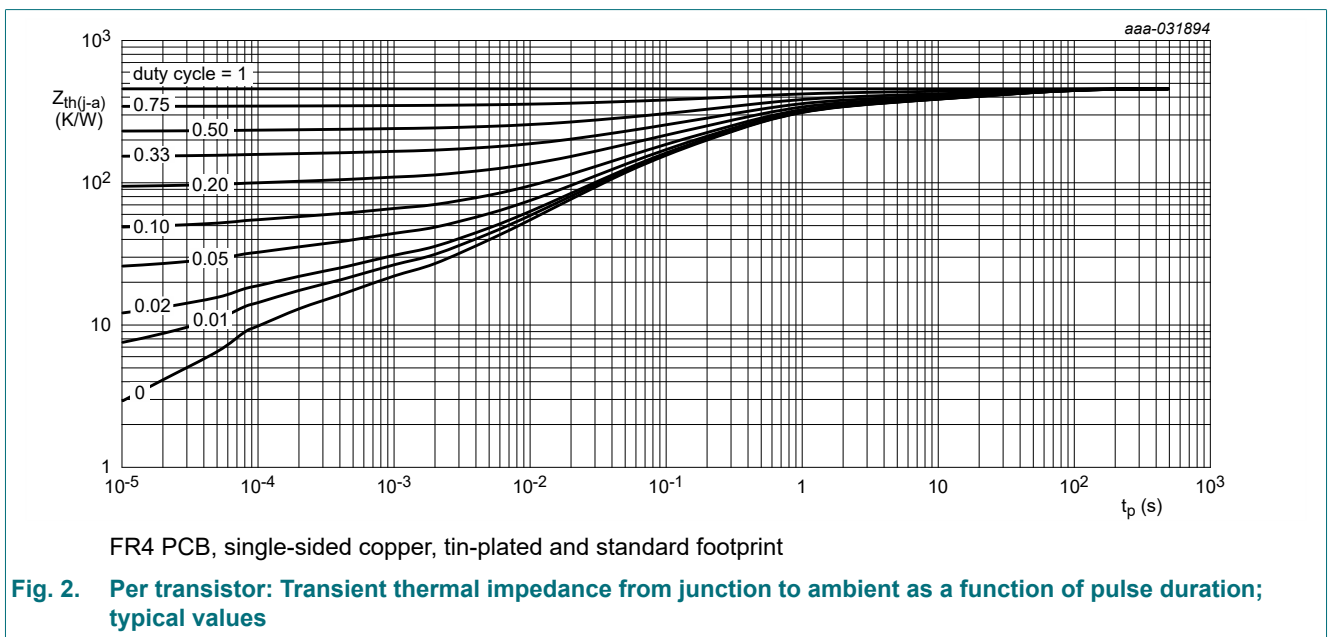
## 9. Thermal characteristics

**Table 7. Thermal characteristics**

$T_{amb} = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	532	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	150	K/W
<b>Per device</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	358	K/W

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



## 10. Characteristics

**Table 8. Characteristics**
 $T_{amb} = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = -100\text{ }\mu\text{A}$ ; $I_E = 0\text{ A}$	-80	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = -2\text{ mA}$ ; $I_B = 0\text{ A}$	-80	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = -80\text{ V}$ ; $I_E = 0\text{ A}$	-	-	-100	nA
$I_{CEO}$	collector-emitter cut-off current	$V_{CE} = -60\text{ V}$ ; $I_B = 0\text{ A}$	-	-	-100	nA
		$V_{CE} = -60\text{ V}$ ; $I_B = 0\text{ A}$ ; $T_j = 150\text{ °C}$	-	-	-5	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current					
	NHUMB10	$V_{EB} = -7\text{ V}$ ; $I_C = 0\text{ A}$	-	-	-270	$\mu\text{A}$
	NHUMB13		-	-	-260	$\mu\text{A}$
	NHUMB9		-	-	-230	$\mu\text{A}$
$h_{FE}$	DC current gain	$V_{CE} = -5\text{ V}$ ; $I_C = -10\text{ mA}$	100	-	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = -10\text{ mA}$ ; $I_B = -0.5\text{ mA}$	-	-	-100	mV
$V_{I(off)}$	off-state input voltage					
	NHUMB10	$V_{CE} = -5\text{ V}$ ; $I_C = -100\text{ }\mu\text{A}$	-	-595	-500	mV
	NHUMB13			-625	-500	mV
	NHUMB9			-690	-500	mV
$V_{I(on)}$	on-state input voltage					
	NHUMB10	$V_{CE} = -0.3\text{ V}$ ; $I_C = -10\text{ mA}$	-1.2	-0.81	-	V
	NHUMB13		-1.4	-0.95	-	V
	NHUMB9		-1.6	-1.22	-	V
R1	bias resistor 1 (input) [1]					
	NHUMB10		1.54	2.2	2.86	k $\Omega$
	NHUMB13		3.3	4.7	6.1	k $\Omega$
	NHUMB9		7	10	13	k $\Omega$
R2/R1	bias resistor ratio [1]					
	NHUMB10		17	21	26	
	NHUMB13		8	10	12	
	NHUMB9		3.7	4.7	5.7	
$f_T$	transition frequency	$V_{CE} = -5\text{ V}$ ; $I_C = -10\text{ mA}$ ; $f = 100\text{ MHz}$ [2]	-	150	-	MHz
$C_c$	collector capacitance	$V_{CB} = -10\text{ V}$ ; $I_E = I_C = 0\text{ A}$ ; $f = 1\text{ MHz}$	-	-	3	pF

[1] See section "Test information" for resistor calculation and test conditions

[2] Characteristics of built-in transistor

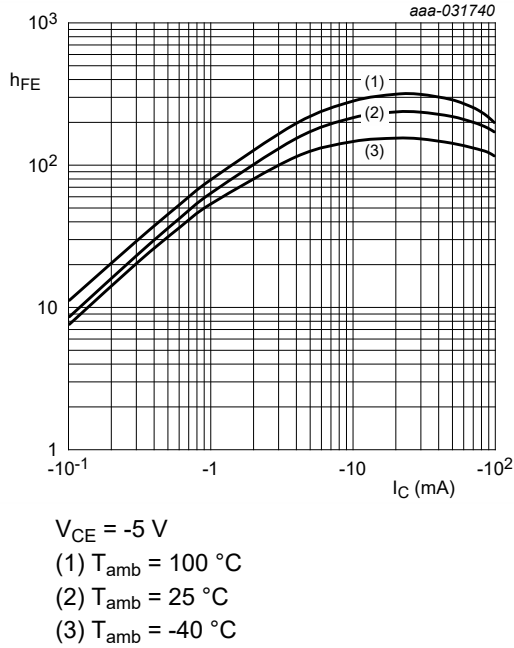


Fig. 3. NHUMB10: DC current gain as a function of collector current; typical values

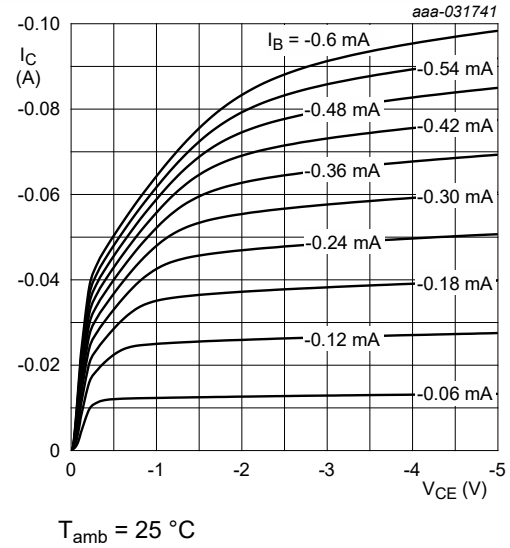


Fig. 4. NHUMB10: Collector current as a function of collector-emitter voltage; typical values

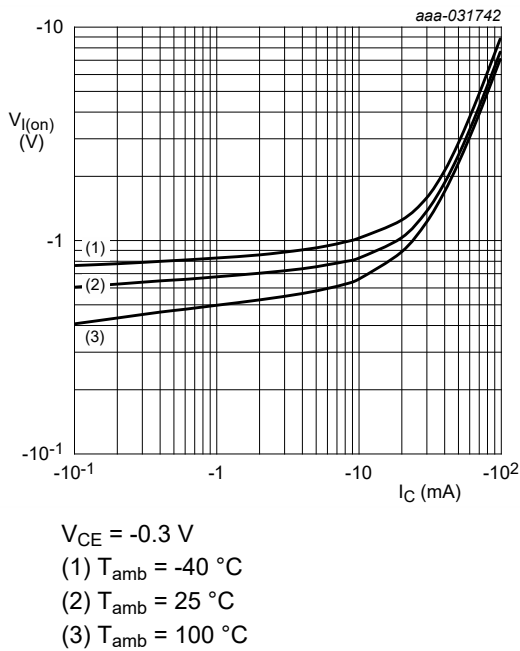


Fig. 5. NHUMB10: On-state input voltage as a function of collector current; typical values

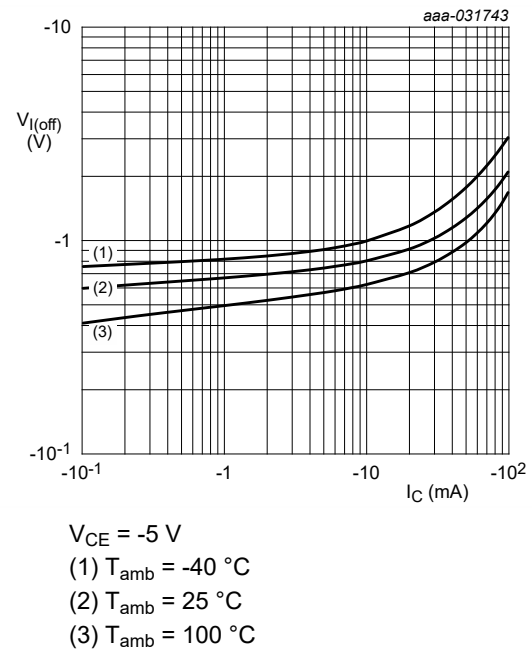
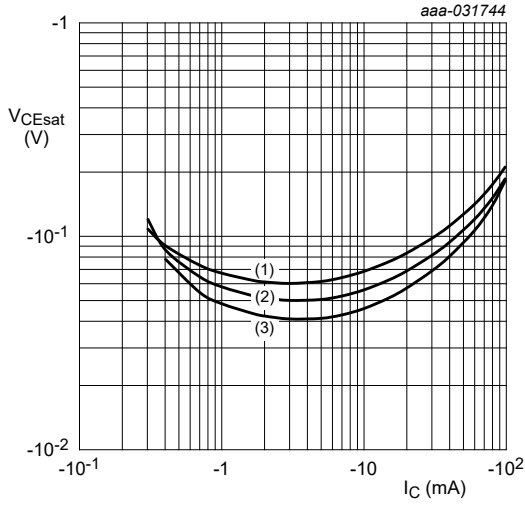
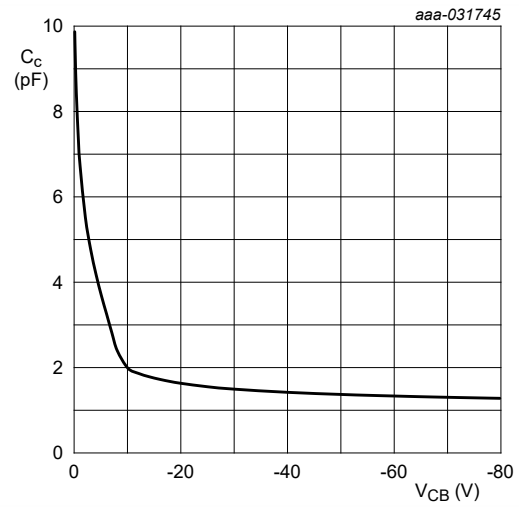


Fig. 6. NHUMB10: Off-state input voltage as a function of collector current; typical values



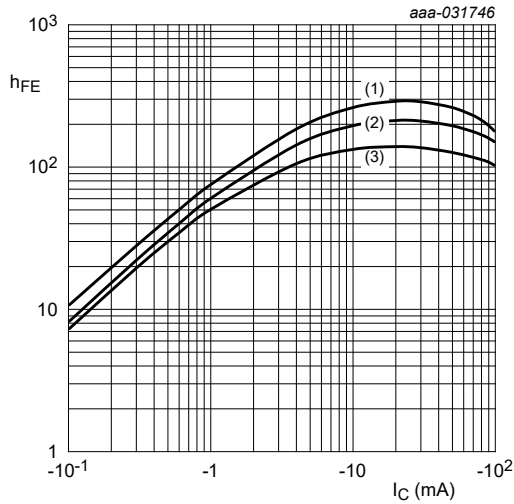
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

Fig. 7. NHUMB10: Collector-emitter saturation voltage as a function of collector current; typical values



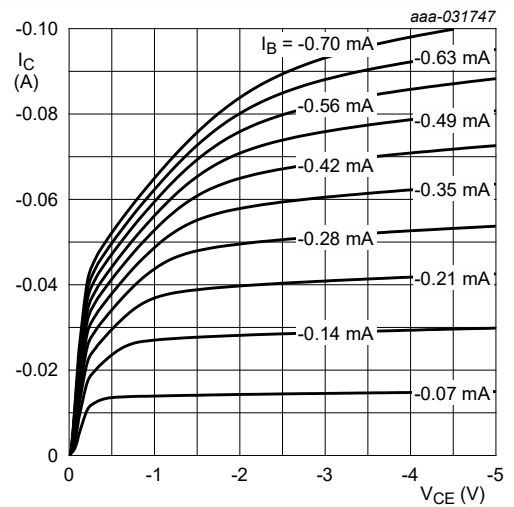
$f = 1\text{ MHz}$   
 $T_{amb} = 25\text{ °C}$

Fig. 8. NHUMB10: Collector capacitance as a function of collector-base voltage; typical values



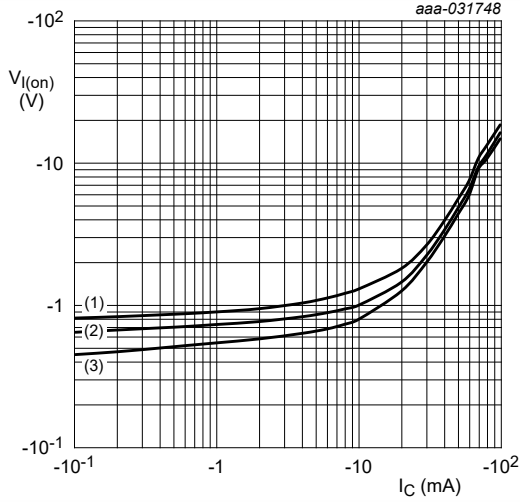
$V_{CE} = -5\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

Fig. 9. NHUMB13: DC current gain as a function of collector current; typical values



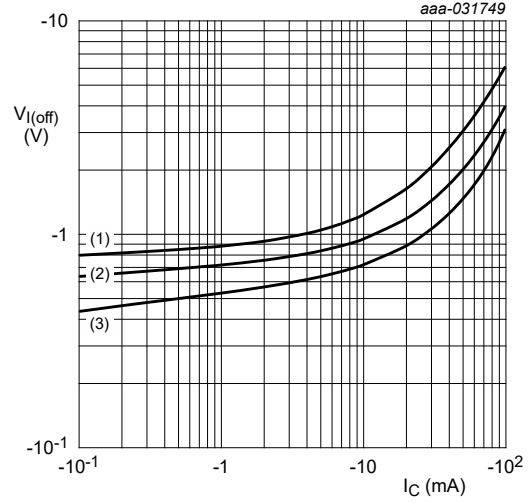
$T_{amb} = 25\text{ °C}$

Fig. 10. NHUMB13: Collector current as a function of collector-emitter voltage; typical values



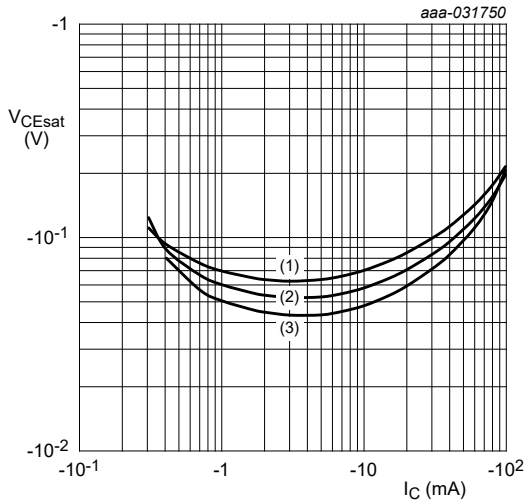
$V_{CE} = -0.3 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**Fig. 11. NHUMB13: On-state input voltage as a function of collector current; typical values**



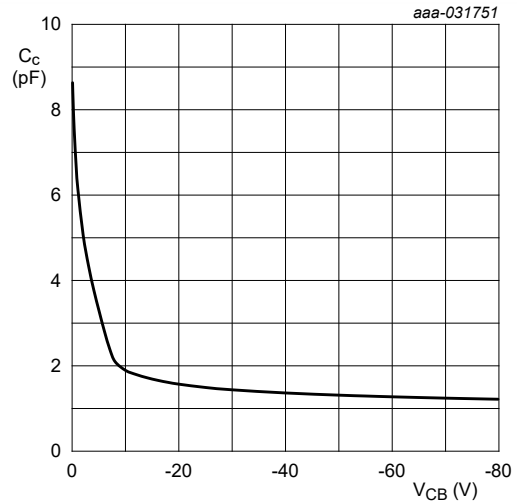
$V_{CE} = -5 \text{ V}$   
 (1)  $T_{amb} = -40 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = 100 \text{ }^\circ\text{C}$

**Fig. 12. NHUMB13: Off-state input voltage as a function of collector current; typical values**



$I_C/I_B = 20$   
 (1)  $T_{amb} = 100 \text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25 \text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -40 \text{ }^\circ\text{C}$

**Fig. 13. NHUMB13: Collector-emitter saturation voltage as a function of collector current; typical values**



$f = 1 \text{ MHz}$   
 $T_{amb} = 25 \text{ }^\circ\text{C}$

**Fig. 14. NHUMB13: Collector capacitance as a function of collector-base voltage; typical values**



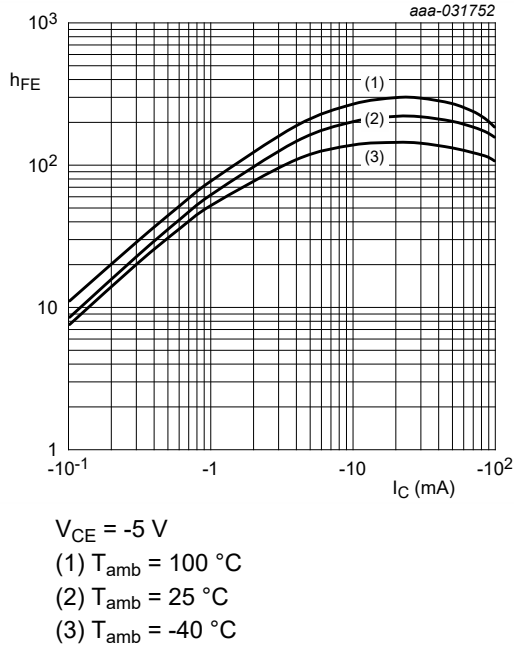


Fig. 15. NHUMB9: DC current gain as a function of collector current; typical values

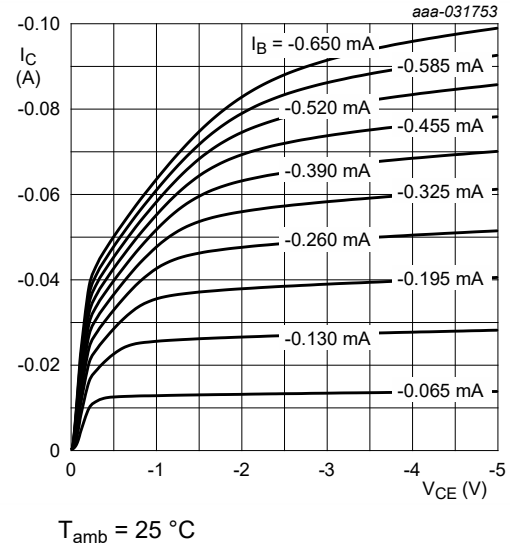


Fig. 16. NHUMB9: Collector current as a function of collector-emitter voltage; typical values

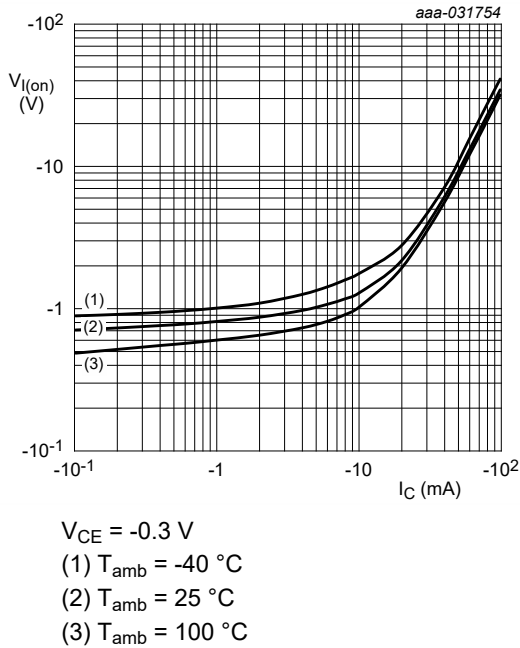


Fig. 17. NHUMB9: On-state input voltage as a function of collector current; typical values

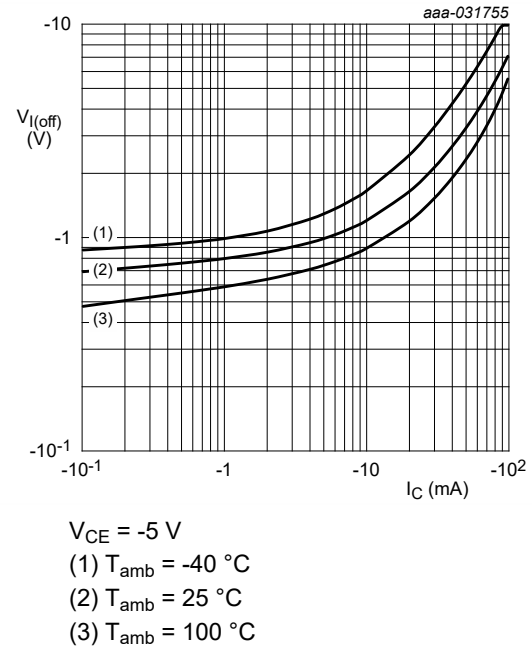
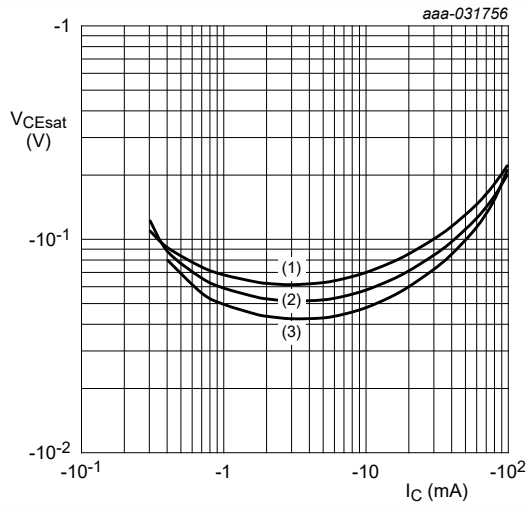
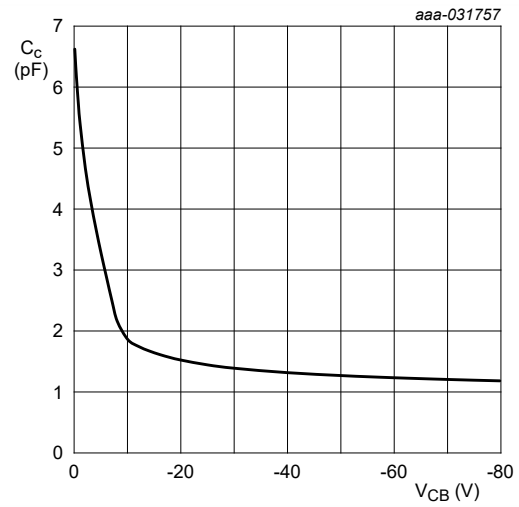


Fig. 18. NHUMB9: Off-state input voltage as a function of collector current; typical values



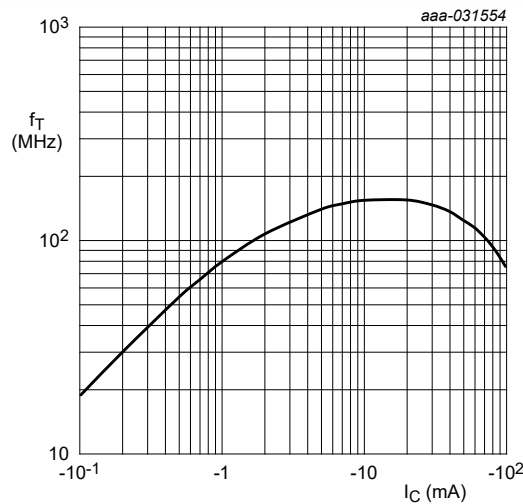
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

Fig. 19. NHUMB9: Collector-emitter saturation voltage as a function of collector current; typical values



$f = 1\text{ MHz}$   
 $T_{amb} = 25\text{ °C}$

Fig. 20. NHUMB9: Collector capacitance as a function of collector-base voltage; typical values



$f = 100\text{ MHz}$   
 $V_{CE} = -5\text{ V}$   
 $T_{amb} = 25\text{ °C}$

Fig. 21. Transition frequency as a function of collector current; typical values of built-in transistor

## 11. Test information

### 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.

### Resistor calculation

- Calculation of bias resistor 1 (R1)

$$R_1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$

- Calculation of bias resistor ratio (R2/R1)

$$\frac{R_2}{R_1} = \frac{V(I_{I4}) - V(I_{I3})}{R_1 \cdot (I_{I4} - I_{I3})} - 1$$

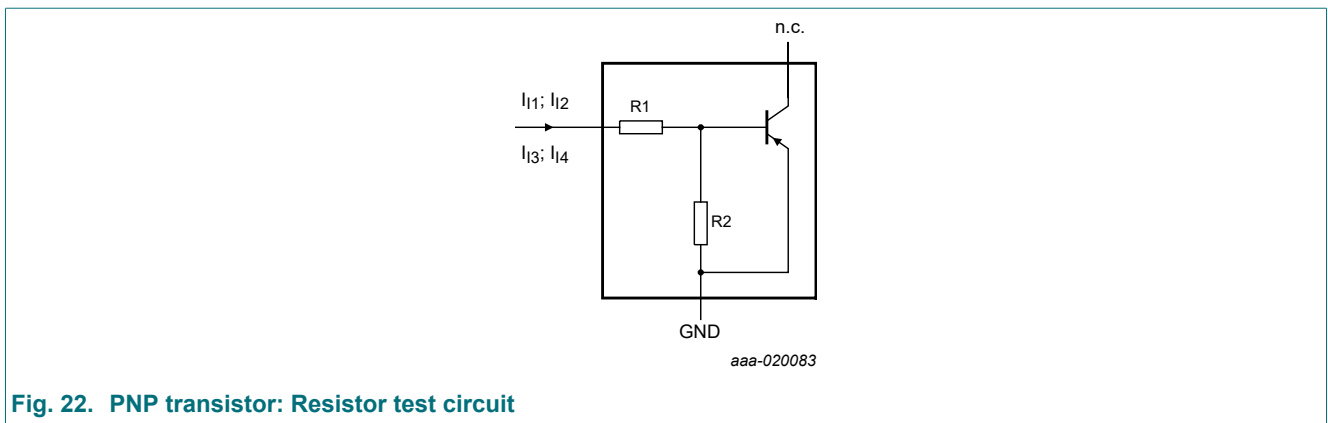


Fig. 22. PNP transistor: Resistor test circuit

### Resistor test conditions

Table 9. Resistor test conditions

Type number	R1 (kΩ)	R2 (kΩ)	Test conditions			
			I <sub>I1</sub>	I <sub>I2</sub>	I <sub>I3</sub>	I <sub>I4</sub>
<b>Per transistor</b>						
NHUMB10	2.2	47	-1.6 mA	-2.4 mA	55 μA	105 μA
NHUMB13	4.7	47	-1.2 mA	-1.8 mA	55 μA	105 μA
NHUMB9	10	47	-0.8 mA	-1.1 mA	55 μA	105 μA

## 12. Package outline

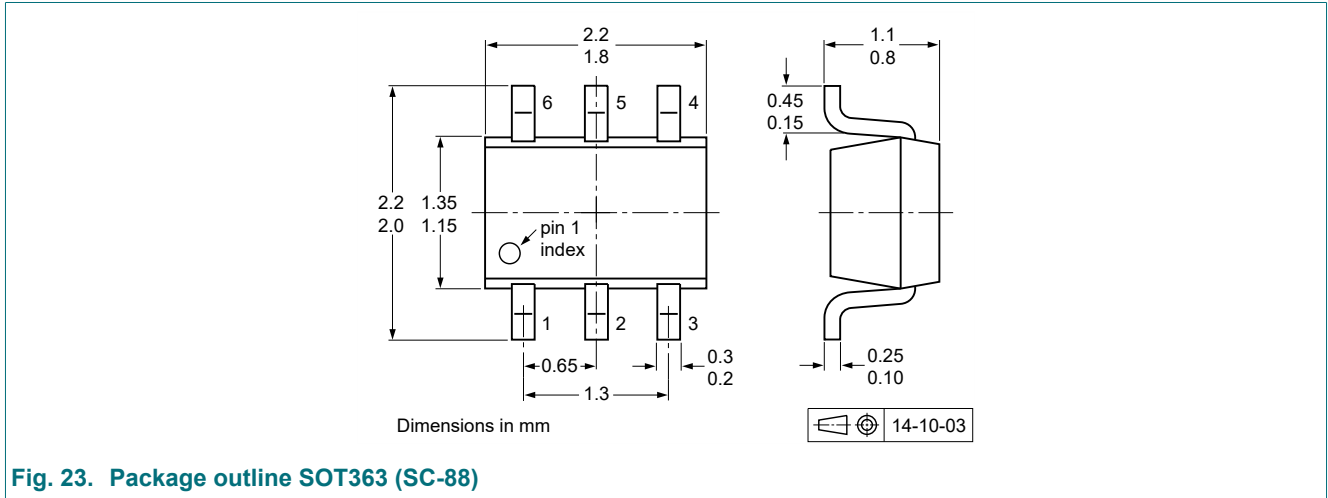


Fig. 23. Package outline SOT363 (SC-88)

## 13. Soldering

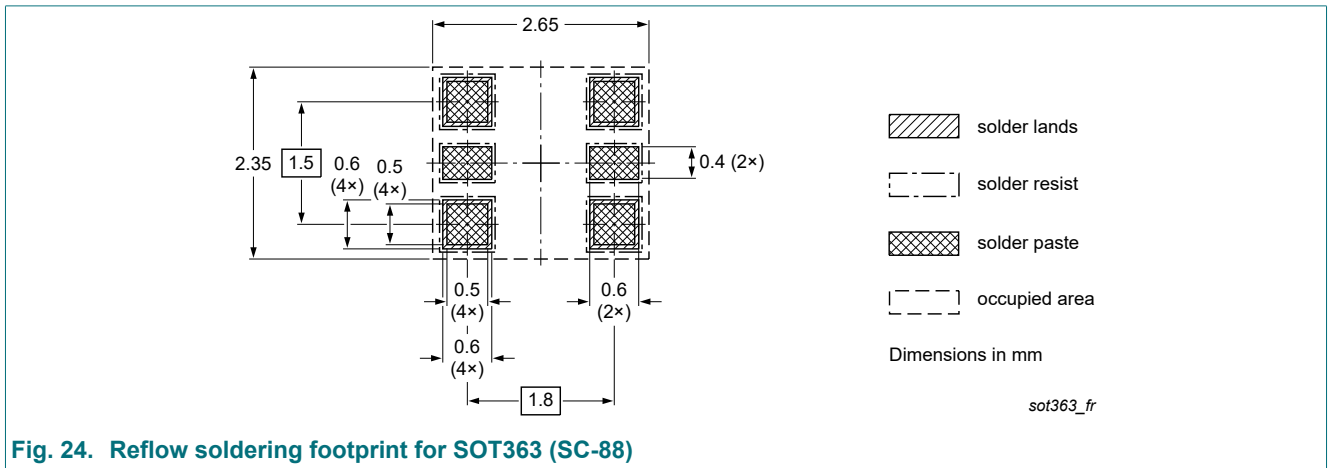


Fig. 24. Reflow soldering footprint for SOT363 (SC-88)

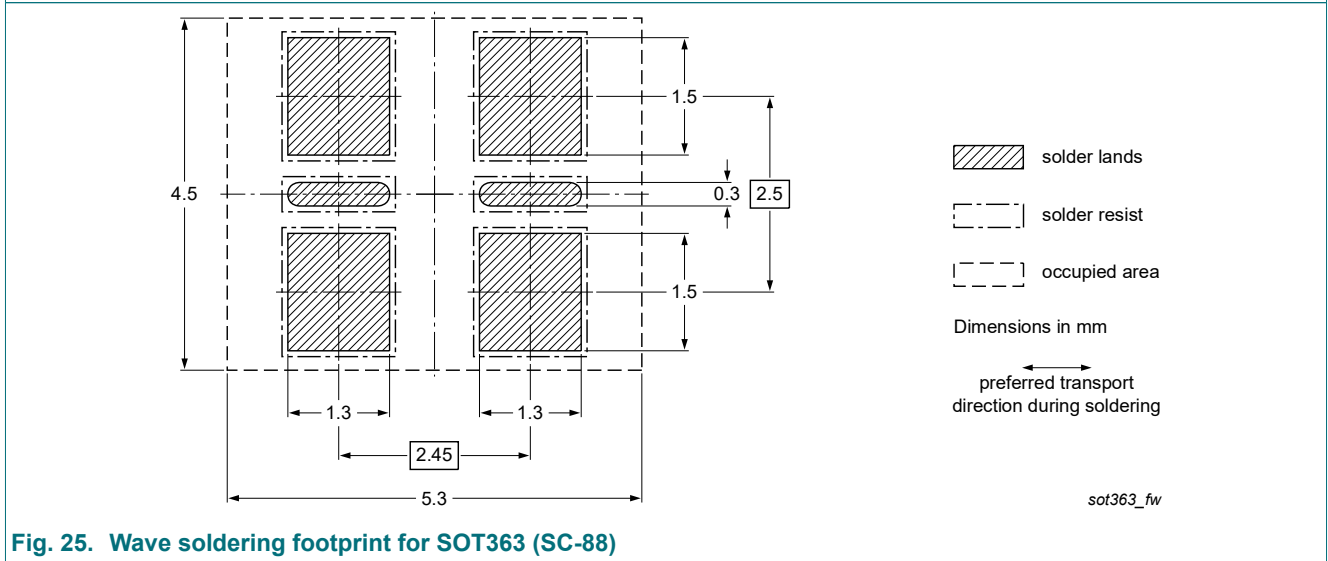


Fig. 25. Wave soldering footprint for SOT363 (SC-88)

## 14. Revision history

Table 10. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NHUMB10_13_9_SER v.1	20200723	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".
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Date of release: 23 July 2020

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