



NHUMH10/13/9 series

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

Rev. 1 — 24 July 2020

Product data sheet

1. General description

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

Table 1. Product overview

Type number	R1	R2	Package		PNP/PNP complement:	NPN/PNP complement:
	k Ω	k Ω	Nexperia	JEITA		
NHUMH10	2.2	47	SOT363	SC-88	NHUMB10	NHUMD10
NHUMH13	4.7	47			NHUMB13	NHUMD13
NHUMH9	10	47			NHUMB9	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 BC846 series in digital applications
- Controlling IC inputs
- Switching loads

4. Quick reference data

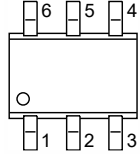
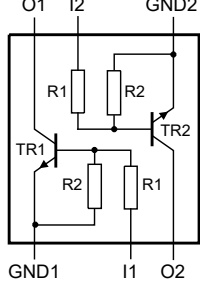
Table 2. Quick reference data

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor						
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
NHUMH10	SC-88	plastic surface-mounted package; 6 leads	SOT363
NHUMH13			
NHUMH9			

7. Marking

Table 5. Marking

Type number	Marking code [1]
NHUMH10	6H%
NHUMH13	6K%
NHUMH9	6G%

[1] % = placeholder for manufacturing site code

8. Limiting values

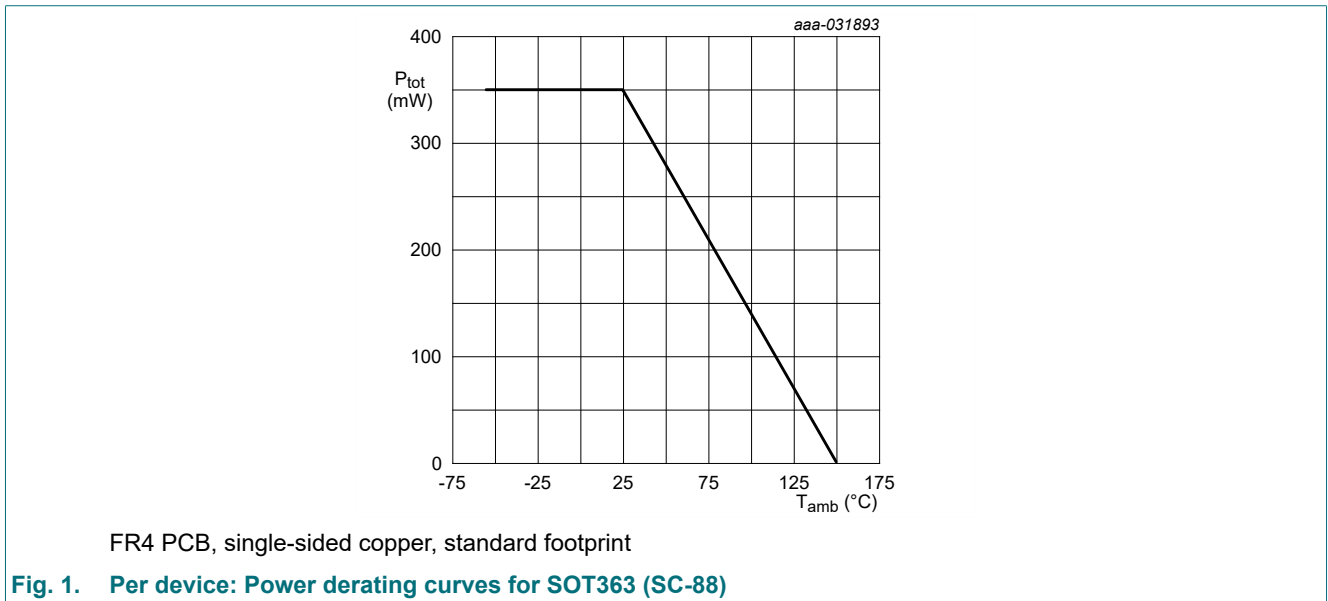
Table 6. Limiting values

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

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

Symbol	Parameter	Conditions	Min	Max	Unit
Per transistor					
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				
	NHUMH10		-7	+20	V
	NHUMH13		-7	+30	V
	NHUMH9		-7	+40	V
I_O	output current		-	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	235	mW
Per device					
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.



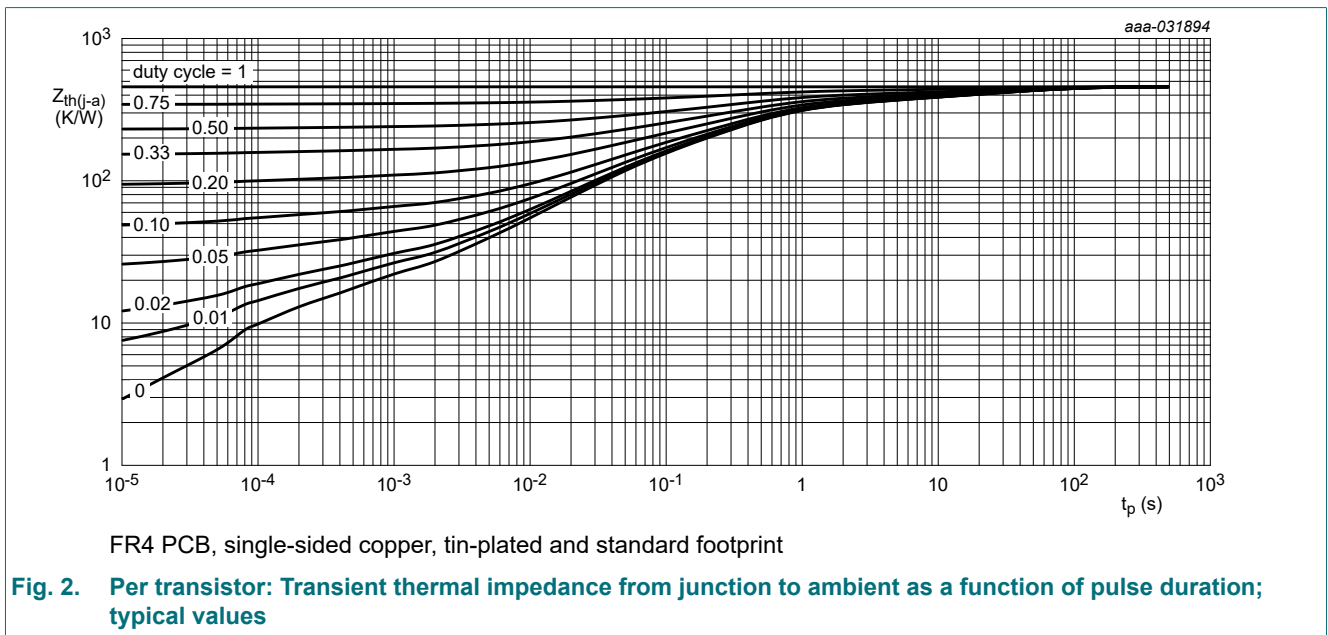
9. Thermal characteristics

Table 7. Thermal characteristics

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Per transistor							
$R_{th(j-a)}$	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
Per device							
$R_{th(j-a)}$	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
Per transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100\ \mu\text{A}; I_E = 0\ \text{A}$	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	μA
I_{EBO}	emitter-base cut-off current					
	NHUMH10	$V_{EB} = 7\ \text{V}; I_C = 0\ \text{A}$	-	-	270	μA
	NHUMH13		-	-	260	μA
	NHUMH9		-	-	230	μA
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					
	NHUMH10	$V_{CE} = 5\ \text{V}; I_C = 100\ \mu\text{A}$	-	595	500	mV
	NHUMH13		-	625	500	mV
	NHUMH9		-	690	500	mV
$V_{I(on)}$	on-state input voltage					
	NHUMH10	$V_{CE} = 0.3\ \text{V}; I_C = 10\ \text{mA}$	1.2	0.81	-	V
	NHUMH13		1.4	0.95	-	V
	NHUMH9		1.6	1.22	-	V
R1	bias resistor 1 (input)					
	NHUMH10	[1]	1.54	2.2	2.86	k Ω
	NHUMH13		3.3	4.7	6.1	k Ω
	NHUMH9		7	10	13	k Ω
R2/R1	bias resistor ratio					
	NHUMH10	[1]	17	21	26	
	NHUMH13		8	10	12	
	NHUMH9		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]	170	-	MHz
C_c	collector capacitance	$V_{CB} = 10\ \text{V}; I_E = I_e = 0\ \text{A}; f = 1\ \text{MHz}$	-	-	2.5	pF

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

[2] Characteristics of built-in transistor

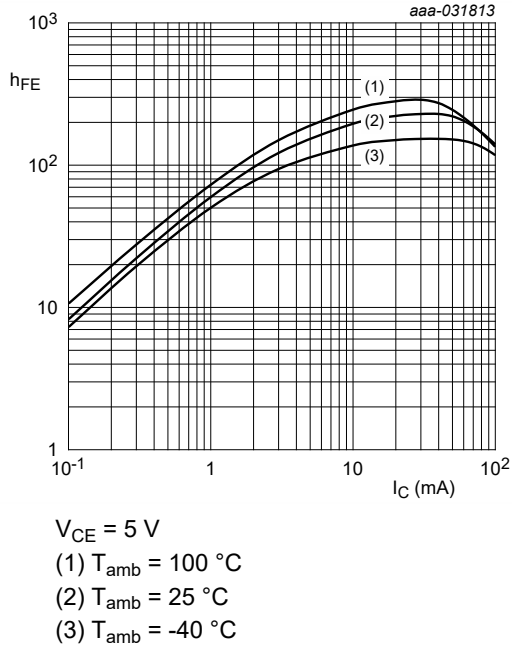


Fig. 3. NHUMH10: DC current gain as a function of collector current; typical values

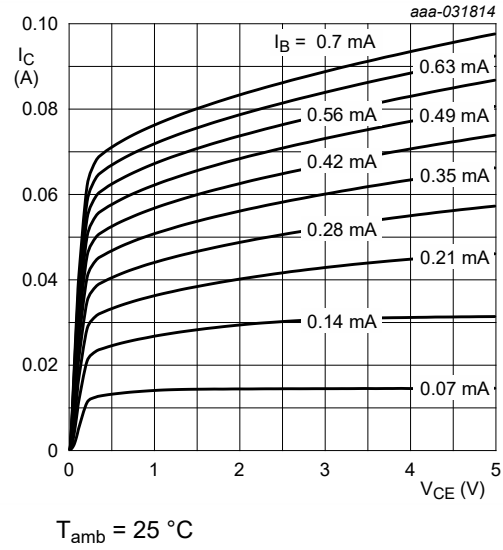


Fig. 4. NHUMH10: Collector current as a function of collector-emitter voltage; typical values

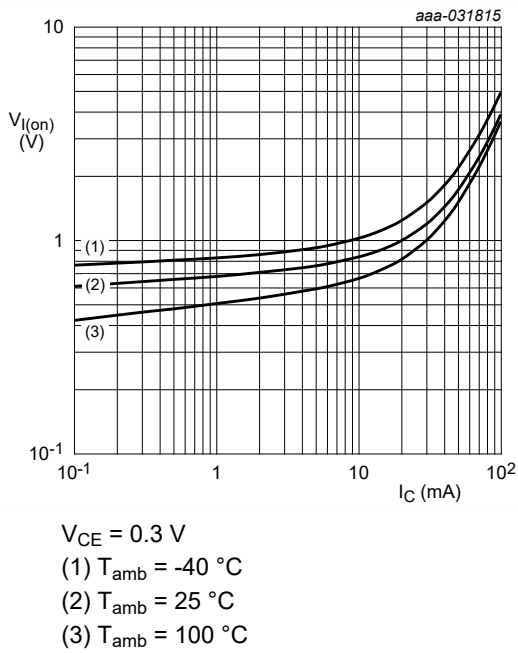


Fig. 5. NHUMH10: On-state input voltage as a function of collector current; typical values

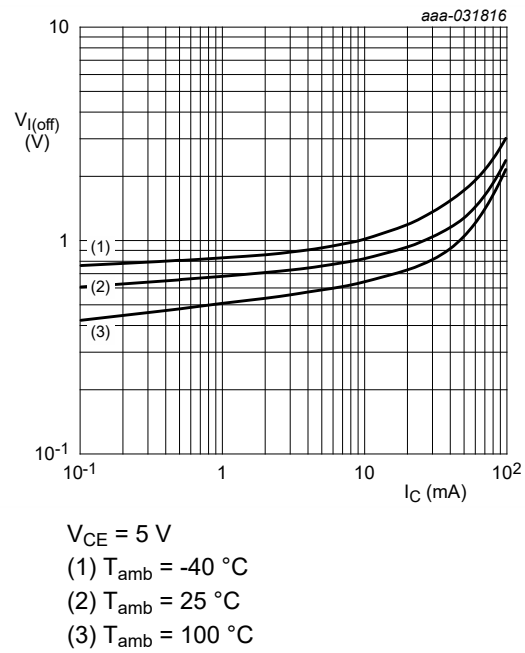


Fig. 6. NHUMH10: Off-state input voltage as a function of collector current; typical values

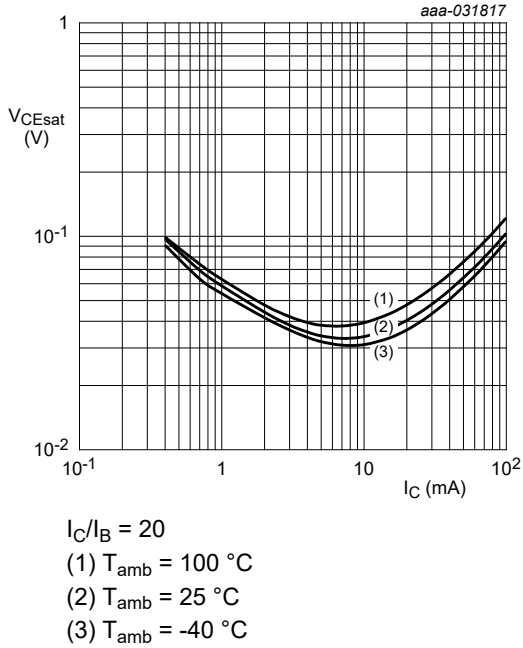


Fig. 7. NHUMH10: Collector-emitter saturation voltage as a function of collector current; typical values

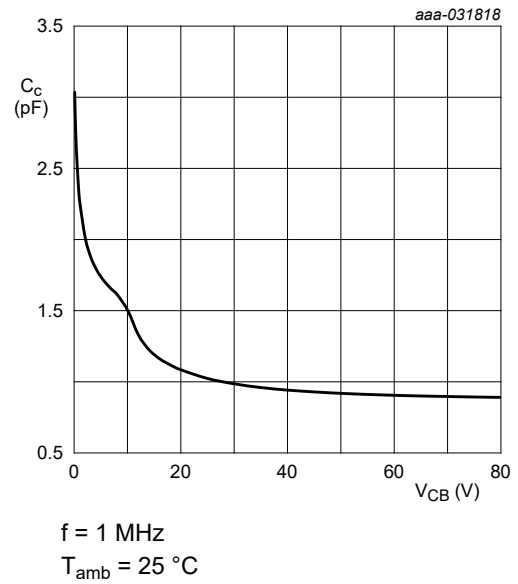


Fig. 8. NHUMH10: Collector capacitance as a function of collector-base voltage; typical values

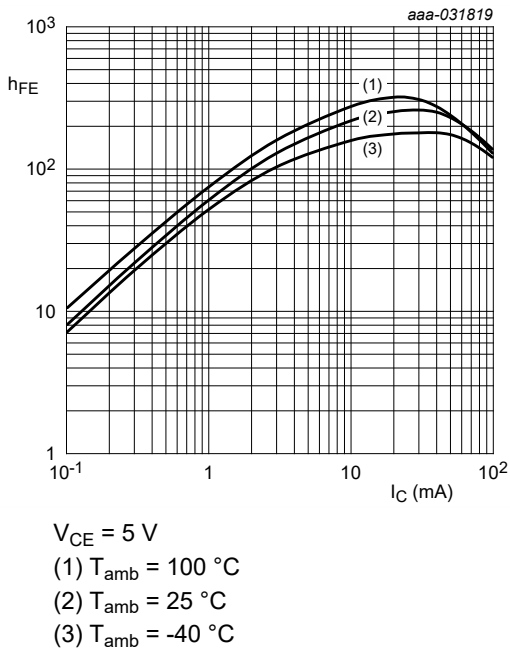


Fig. 9. NHUMH13: DC current gain as a function of collector current; typical values

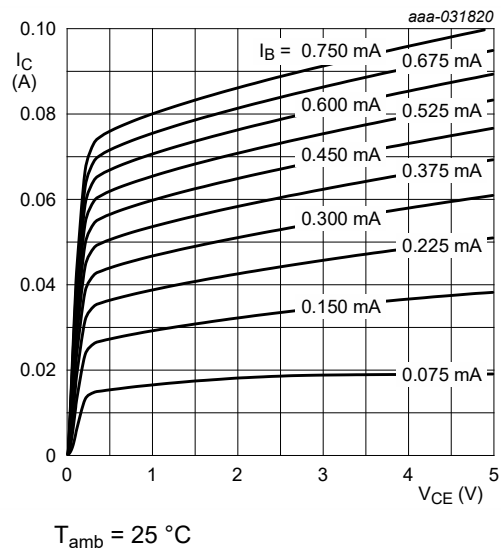
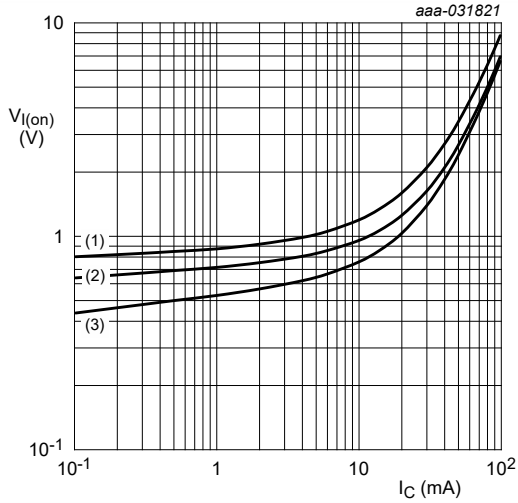
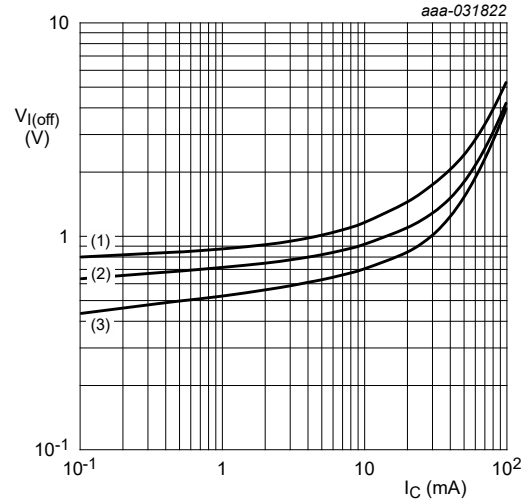


Fig. 10. NHUMH13: Collector current as a function of collector-emitter voltage; typical values



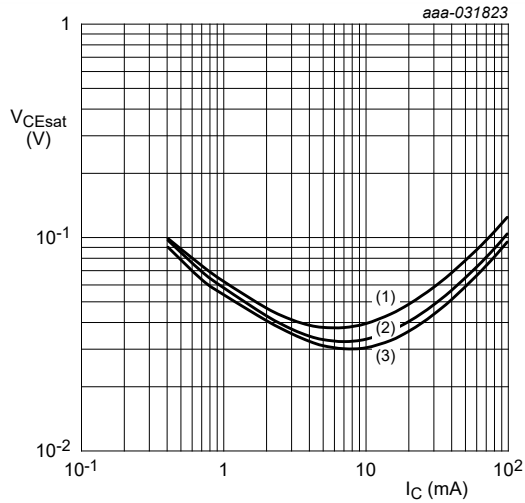
$V_{CE} = 0.3 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 11. NHUMH13: On-state input voltage as a function of collector current; typical values



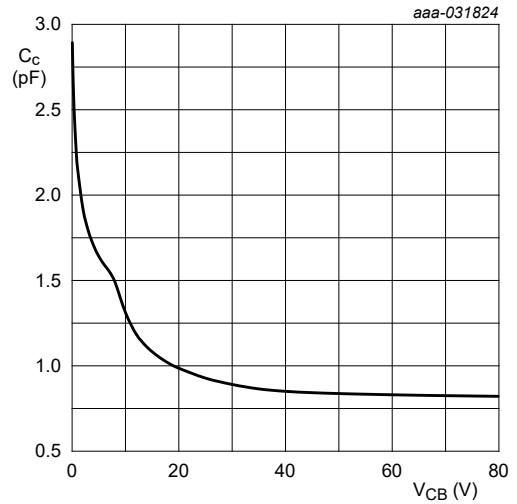
$V_{CE} = 5 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 12. NHUMH13: 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. NHUMH13: 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. NHUMH13: Collector capacitance as a function of collector-base voltage; typical values

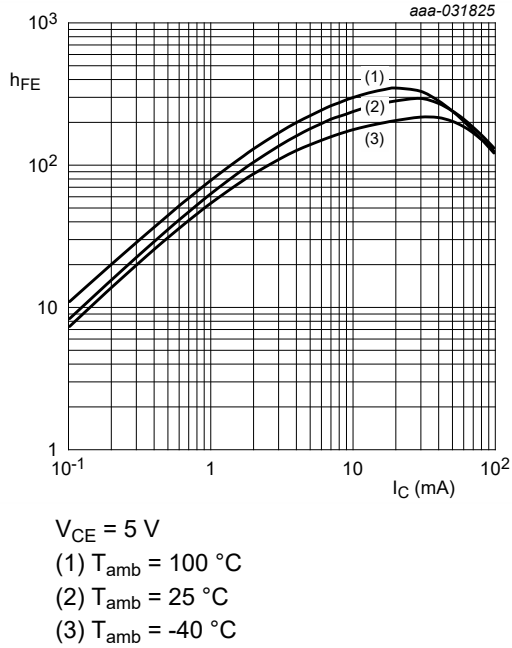


Fig. 15. NHUMH9: DC current gain as a function of collector current; typical values

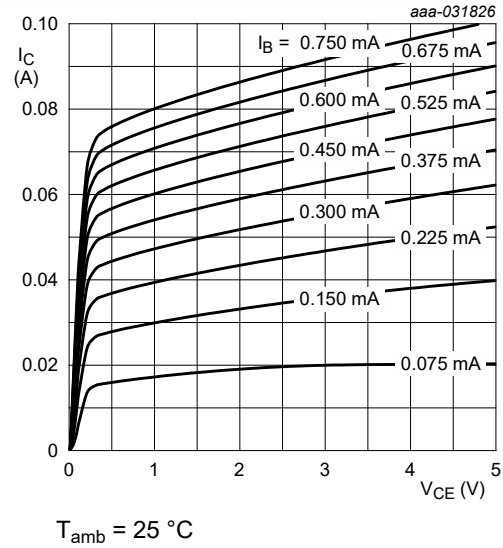


Fig. 16. NHUMH9: Collector current as a function of collector-emitter voltage; typical values

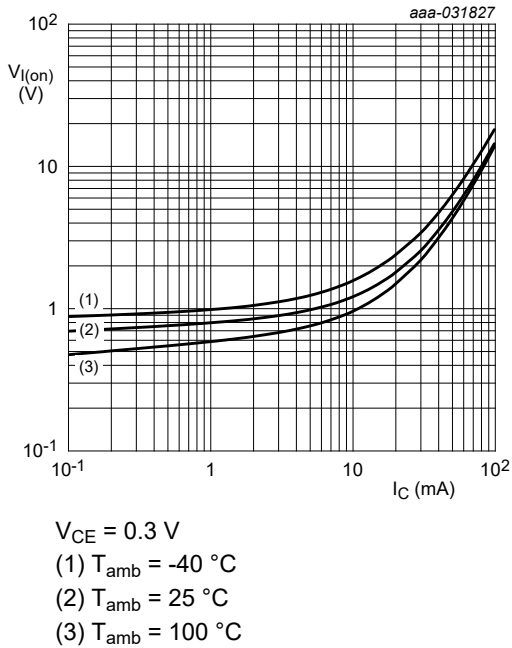


Fig. 17. NHUMH9: On-state input voltage as a function of collector current; typical values

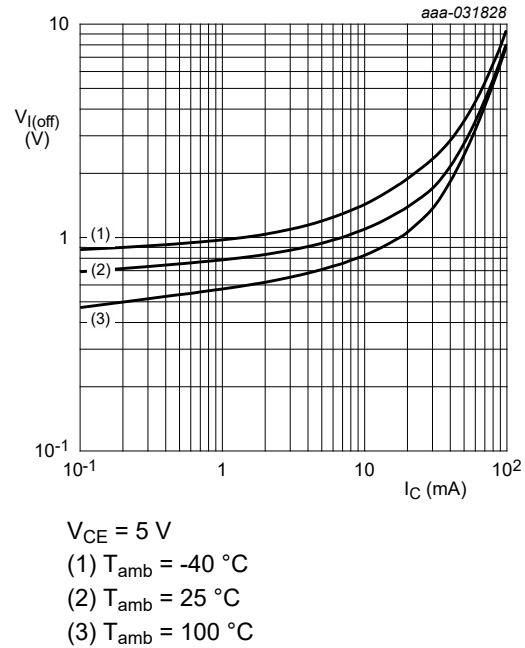
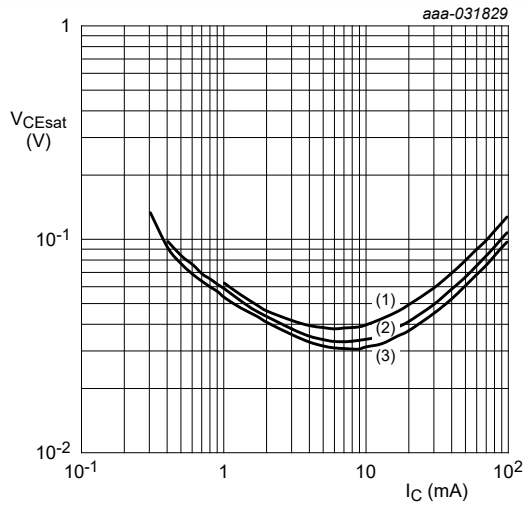
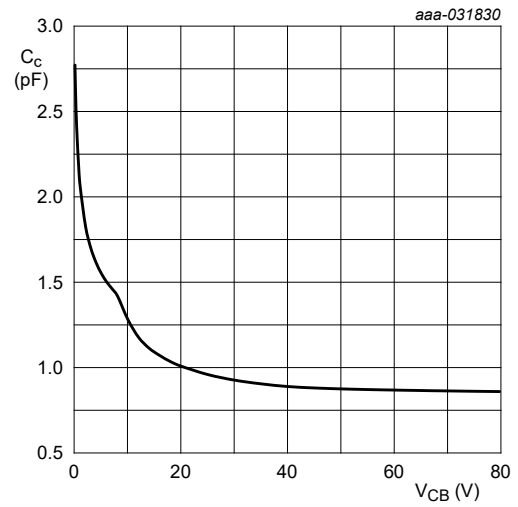


Fig. 18. NHUMH9: Off-state input voltage as a function of collector current; typical values



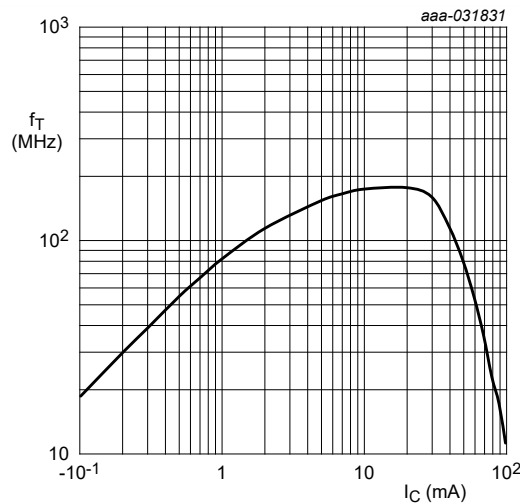
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 19. NHUMH9: Collector-emitter saturation voltage as a function of collector current; typical values



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

Fig. 20. NHUMH9: 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)

$$R1 = \frac{V(I12) - V(I11)}{I12 - I11}$$

- Calculation of bias resistor ratio (R2/R1)

$$\frac{R2}{R1} = \frac{V(I14) - V(I13)}{R1 \cdot (I14 - I13)} - 1$$

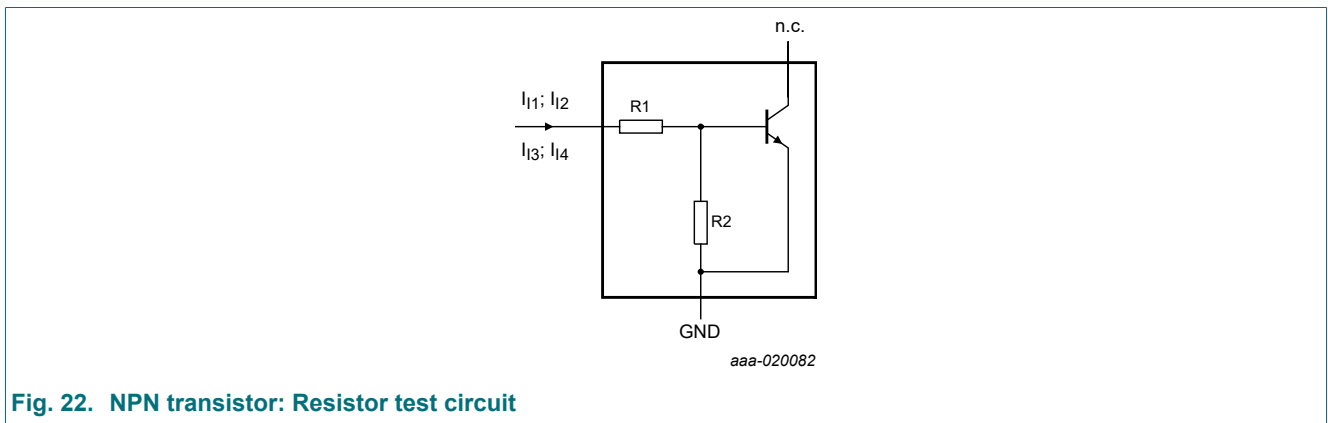


Fig. 22. NPN transistor: Resistor test circuit

Resistor test conditions

Table 9. Resistor test conditions

Type number	R1 (kΩ)	R2 (kΩ)	Test conditions			
			I ₁₁	I ₁₂	I ₁₃	I ₁₄
Per transistor						
NHUMH10	2.2	47	1.6 mA	2.4 mA	-55 μA	-105 μA
NHUMH13	4.7	47	1.2 mA	1.8 mA	-55 μA	-105 μA
NHUMH9	10	47	0.8 mA	1.1 mA	-55 μA	-105 μA

12. Package outline

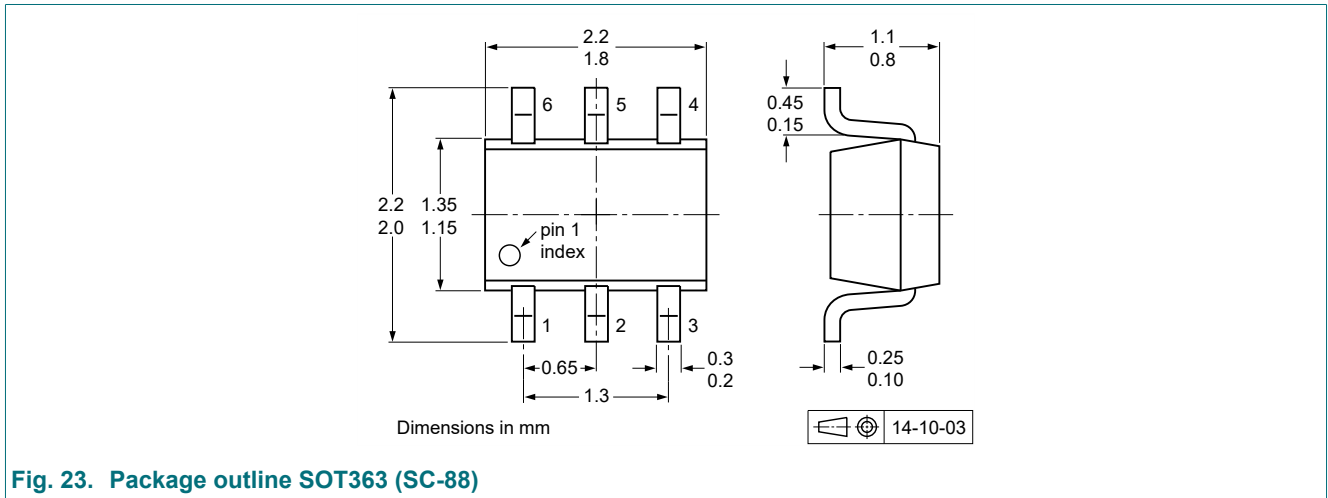


Fig. 23. Package outline SOT363 (SC-88)

13. Soldering

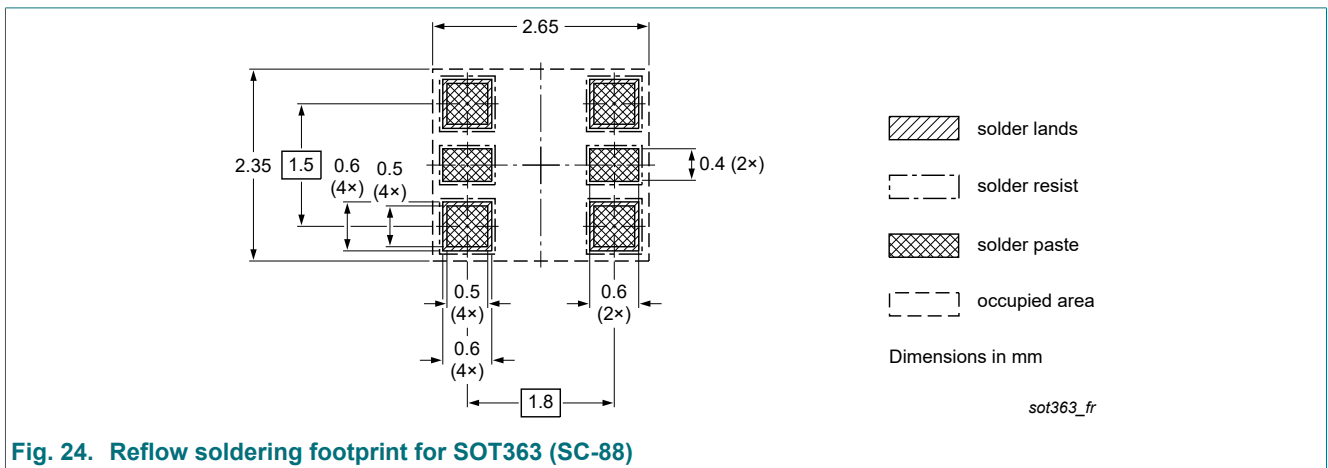


Fig. 24. Reflow soldering footprint for SOT363 (SC-88)

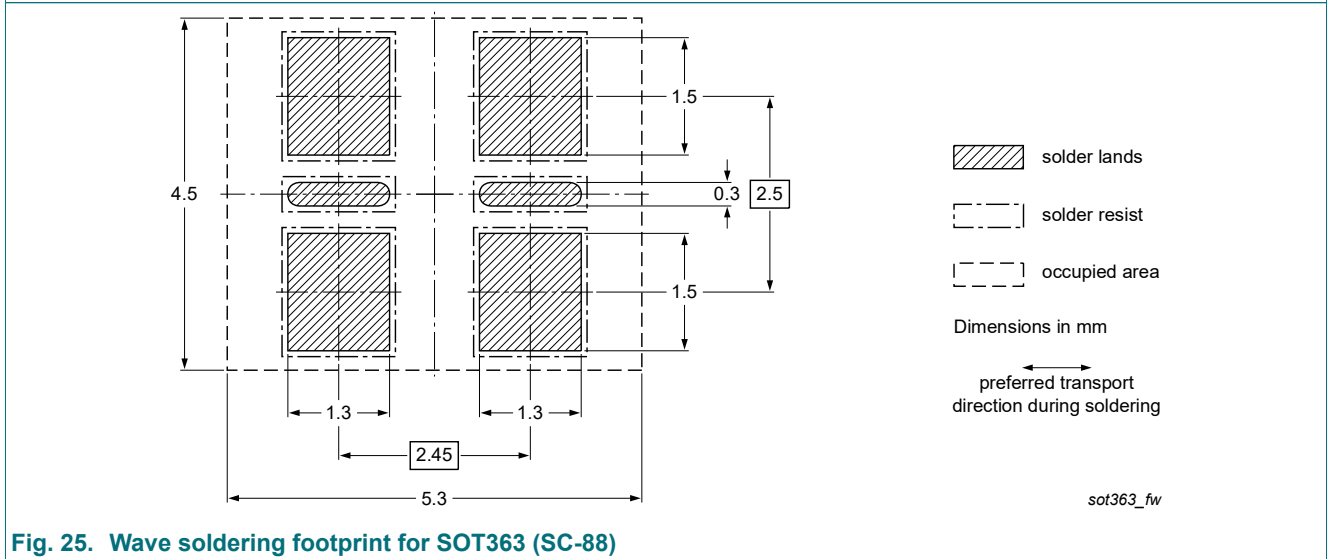


Fig. 25. Wave soldering footprint for SOT363 (SC-88)

14. Revision history

Table 10. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NHUMH10_13_9_SER v.1	20200724	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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