



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

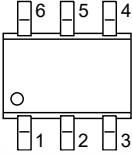
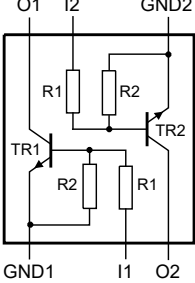
Table 2. Quick reference data

$T_{amb} = 25\text{ }^{\circ}\text{C}$ 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		 aaa-019894
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%

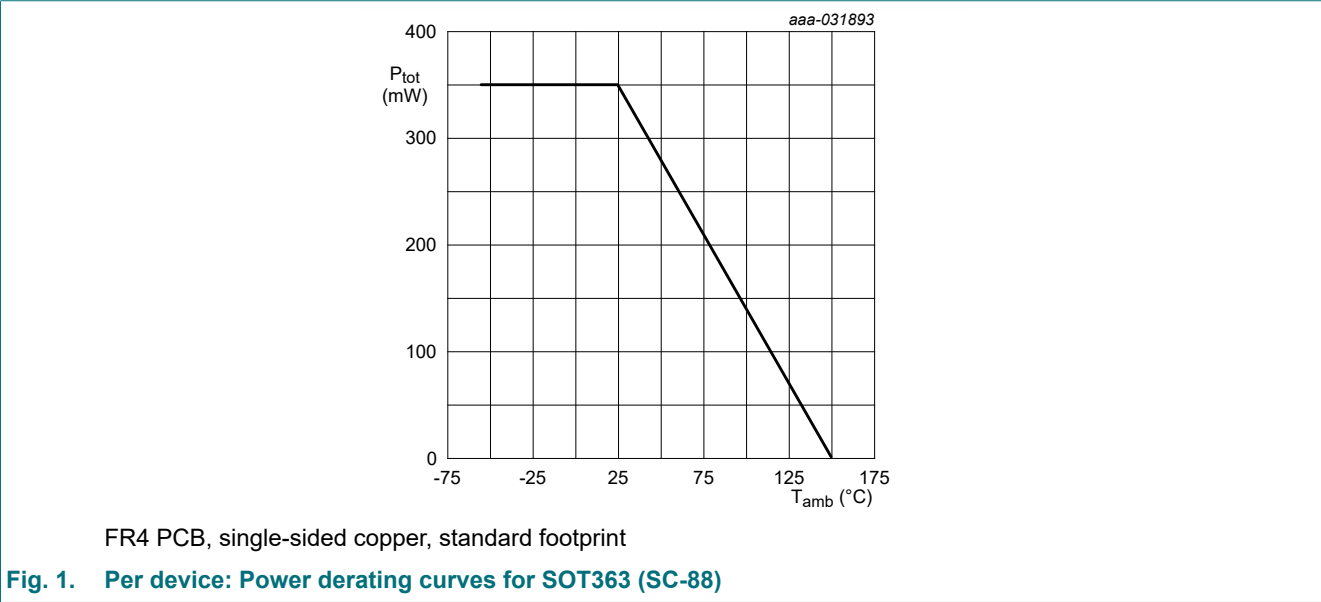
[1] % = placeholder for manufacturing site code

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.



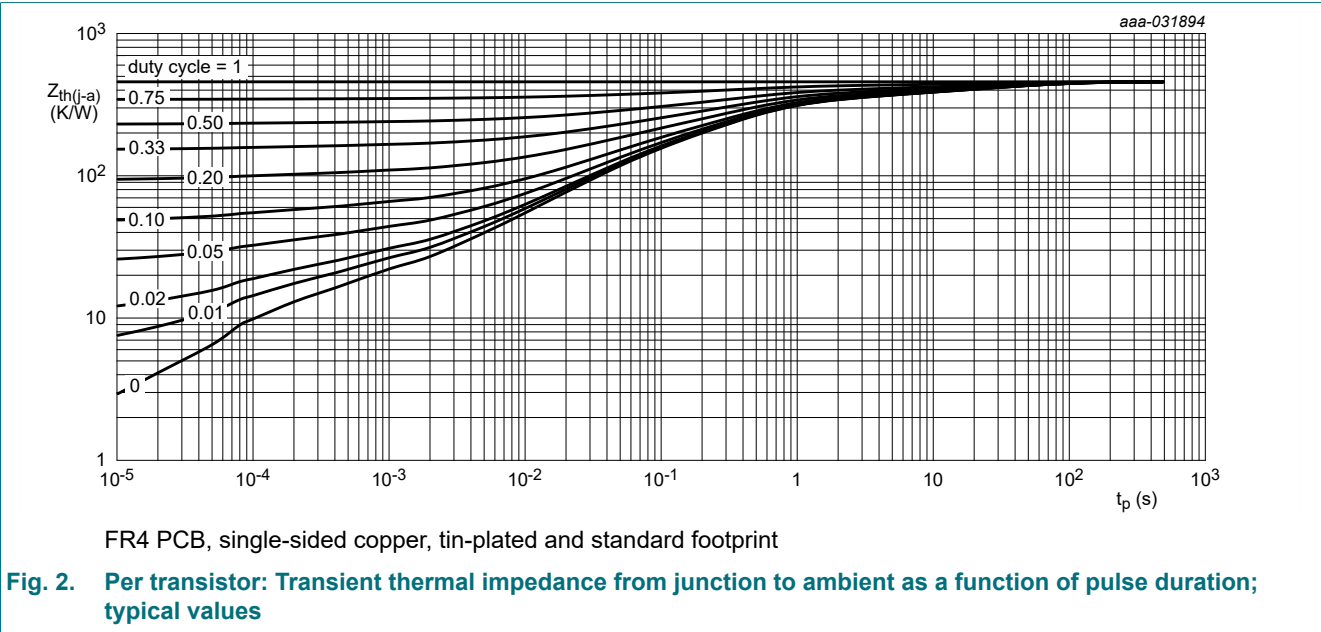
9. Thermal characteristics

Table 7. Thermal characteristics

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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor						
V _{(BR)CBO}	collector-base breakdown voltage	I _C = 100 μA; I _E = 0 A	80	-	-	V
V _{(BR)CEO}	collector-emitter breakdown voltage	I _C = 2 mA; I _B = 0 A	80	-	-	V
I _{CBO}	collector-base cut-off current	V _{CB} = 80 V; I _E = 0 A	-	-	100	nA
I _{CEO}	collector-emitter cut-off current	V _{CE} = 60 V; I _B = 0 A	-	-	100	nA
		V _{CE} = 60 V; I _B = 0 A; T _j = 150 °C	-	-	5	μA
I _{EBO}	emitter-base cut-off current					
	NHUMH10	V _{EB} = 7 V; I _C = 0 A	-	-	270	μA
	NHUMH13		-	-	260	μA
	NHUMH9		-	-	230	μA
h _{FE}	DC current gain	V _{CE} = 5 V; I _C =10 mA	100	-	-	
V _{CEsat}	collector-emitter saturation voltage	I _C = 10 mA; I _B = 0.5 mA	-	-	100	mV
V _{I(off)}	off-state input voltage					
	NHUMH10	V _{CE} = 5 V ; I _C = 100 μA	-	595	500	mV
	NHUMH13		-	625	500	mV
	NHUMH9		-	690	500	mV
V _{I(on)}	on-state input voltage					
	NHUMH10	V _{CE} = 0.3 V ; I _C = 10 mA	1.2	0.81	-	V
	NHUMH13		1.4	0.95	-	V
	NHUMH9		1.6	1.22	-	V
R1	bias resistor 1 (input)					
	NHUMH10		1.54	2.2	2.86	kΩ
	NHUMH13		3.3	4.7	6.1	kΩ
	NHUMH9		7	10	13	kΩ
R2/R1	bias resistor ratio					
	NHUMH10		17	21	26	
	NHUMH13		8	10	12	
	NHUMH9		3.7	4.7	5.7	
f _T	transition frequency	V _{CE} = 5 V; I _C = 10 mA; f = 100 MHz	-	170	-	MHz
C _c	collector capacitance	V _{CB} = 10 V; I _E = i _e = 0 A; f = 1 MHz	-	-	2.5	pF

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

[2] Characteristics of built-in transistor

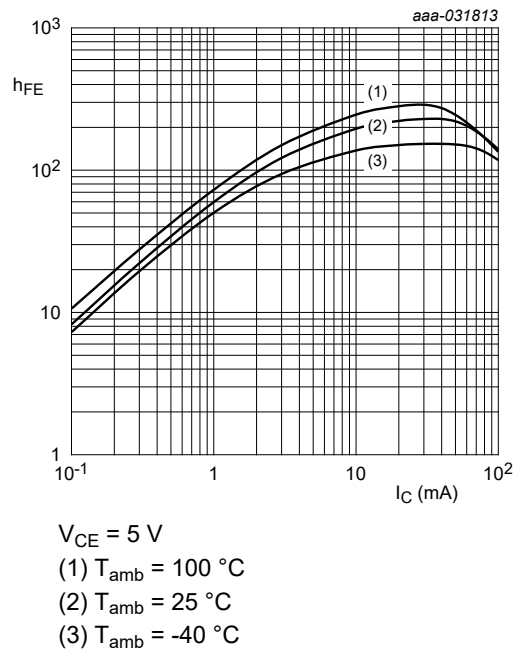


Fig. 3. NHUMH10: DC current gain as a function of collector current; typical values

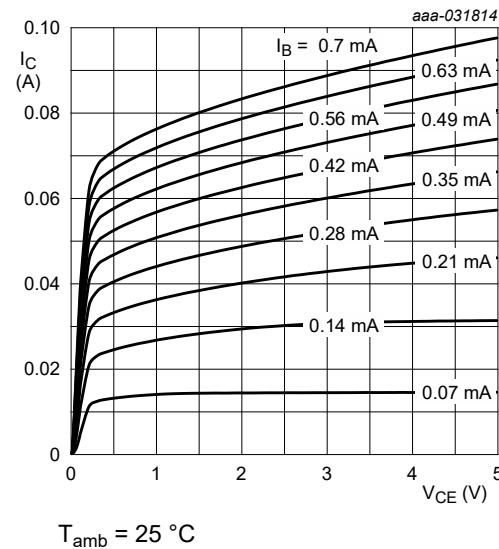


Fig. 4. NHUMH10: Collector current as a function of collector-emitter voltage; typical values

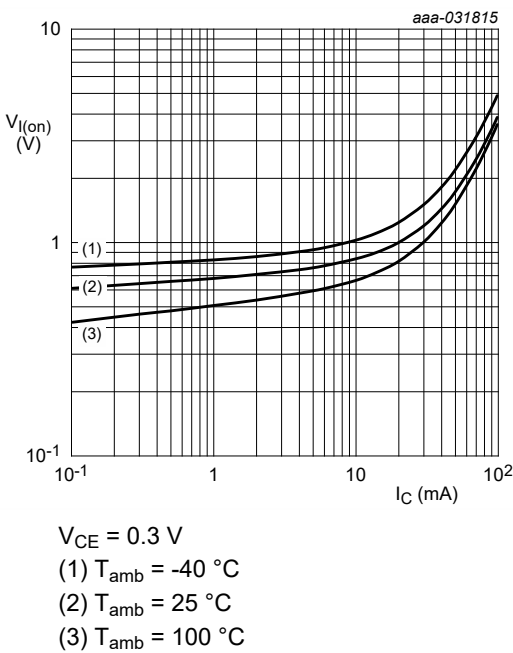


Fig. 5. NHUMH10: On-state input voltage as a function of collector current; typical values

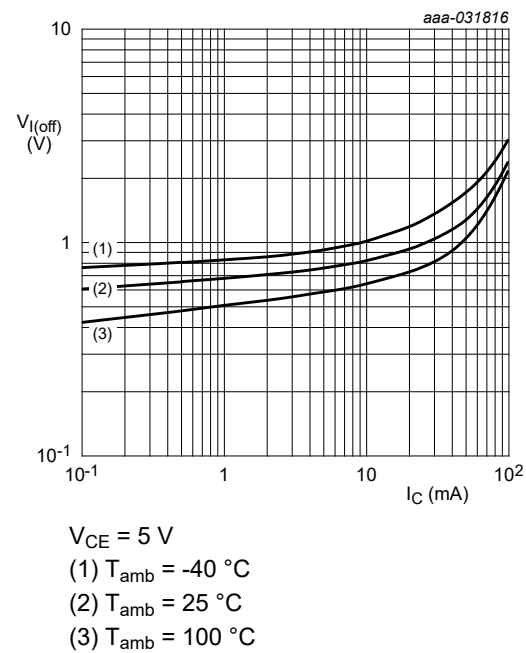


Fig. 6. NHUMH10: Off-state input voltage as a function of collector current; typical values

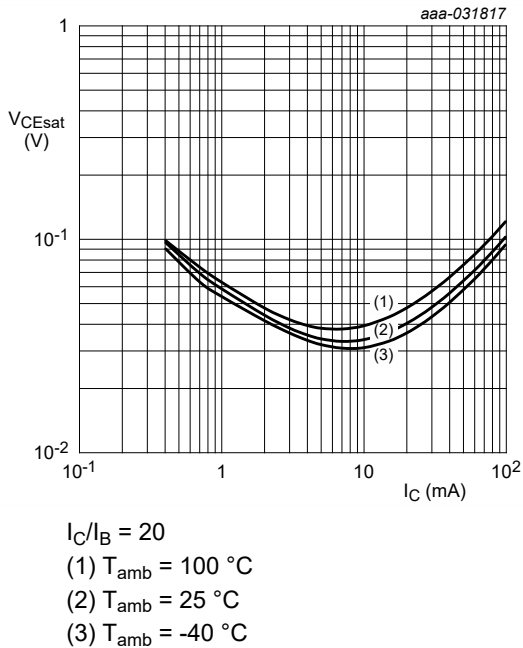


Fig. 7. NHUMH10: Collector-emitter saturation voltage as a function of collector current; typical values

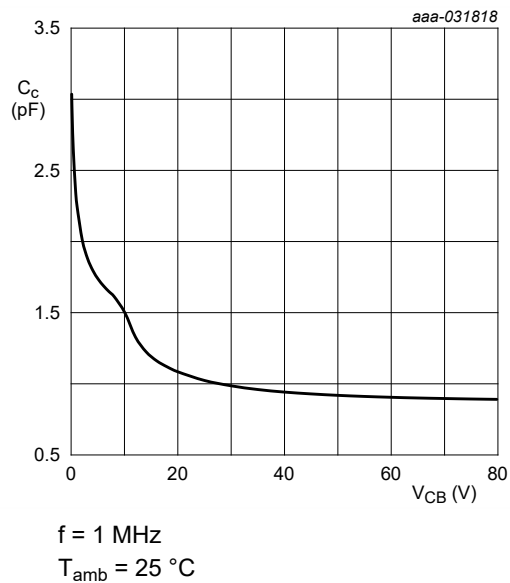


Fig. 8. NHUMH10: Collector capacitance as a function of collector-base voltage; typical values

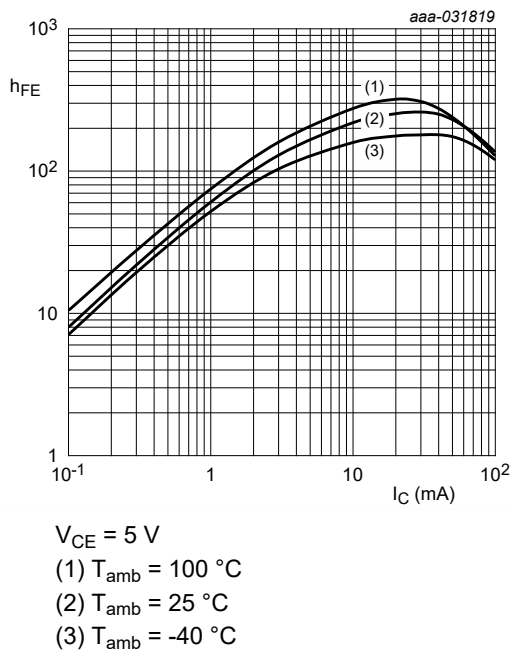


Fig. 9. NHUMH13: DC current gain as a function of collector current; typical values

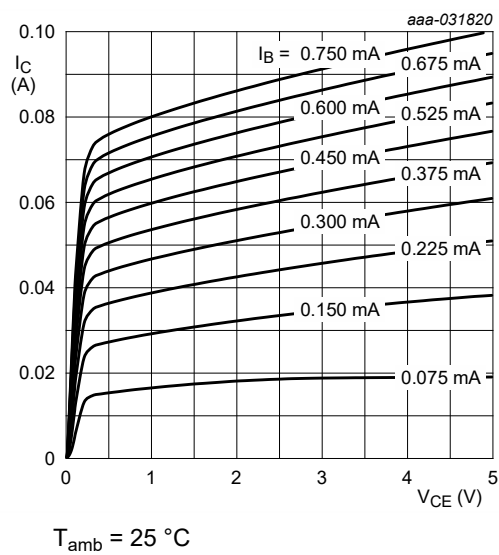


Fig. 10. NHUMH13: Collector current as a function of collector-emitter voltage; typical values

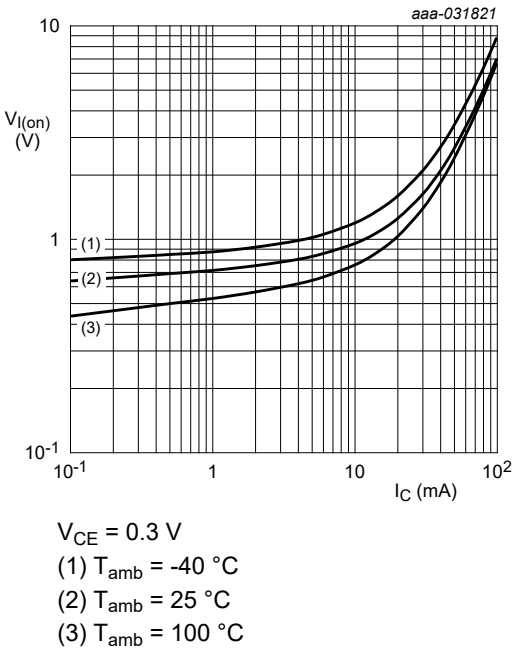


Fig. 11. NHUMH13: On-state input voltage as a function of collector current; typical values

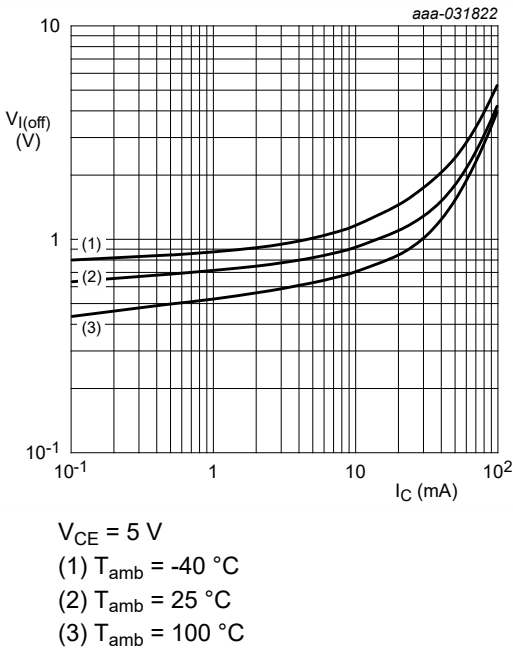


Fig. 12. NHUMH13: Off-state input voltage as a function of collector current; typical values

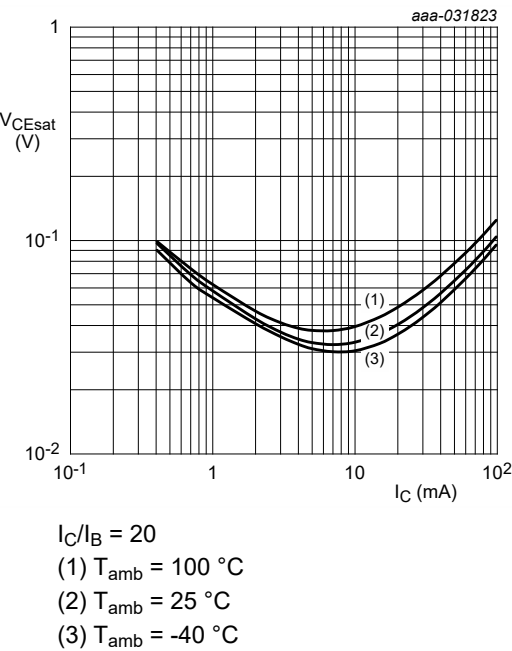


Fig. 13. NHUMH13: Collector-emitter saturation voltage as a function of collector current; typical values

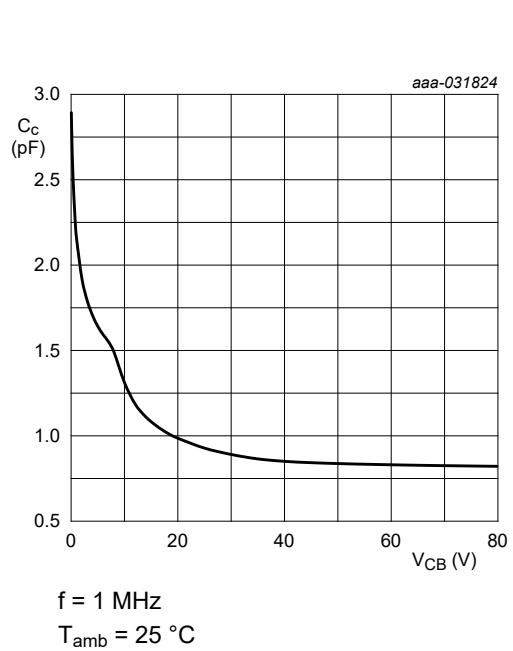


Fig. 14. NHUMH13: Collector capacitance as a function of collector-base voltage; typical values

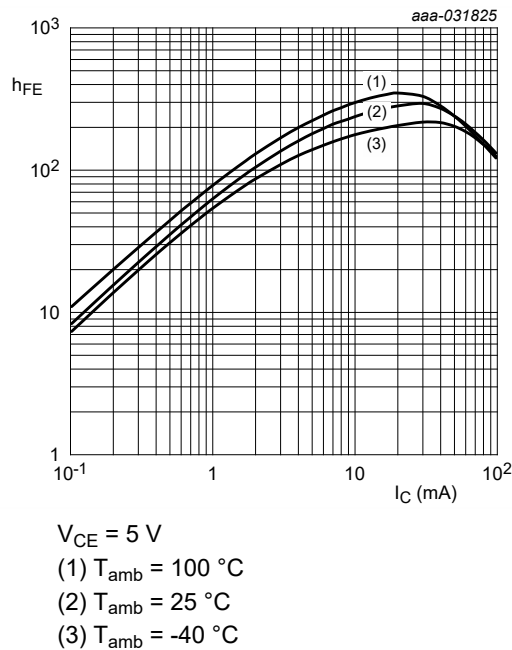


Fig. 15. NHUMH9: DC current gain as a function of collector current; typical values

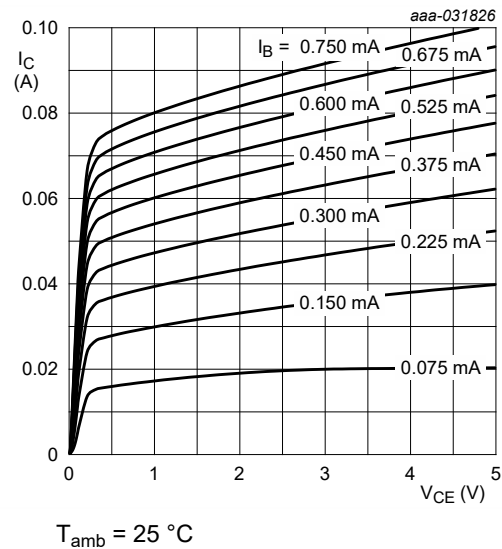


Fig. 16. NHUMH9: Collector current as a function of collector-emitter voltage; typical values

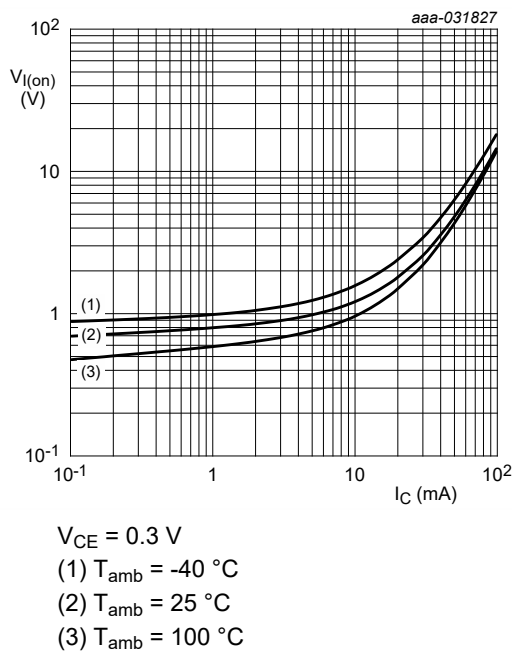


Fig. 17. NHUMH9: On-state input voltage as a function of collector current; typical values

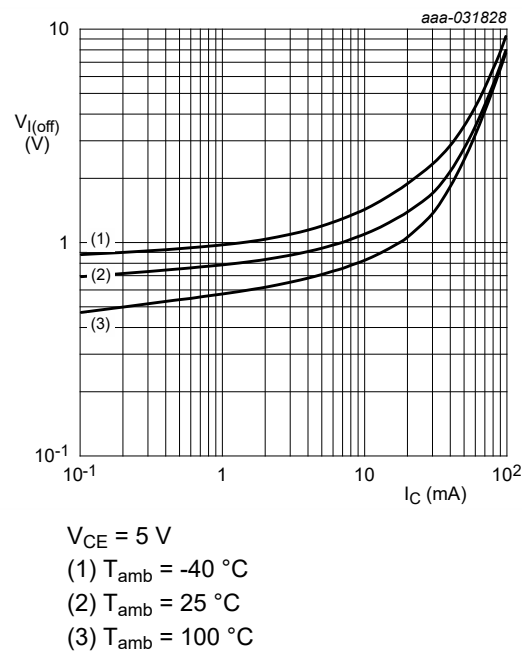


Fig. 18. NHUMH9: Off-state input voltage as a function of collector current; typical values

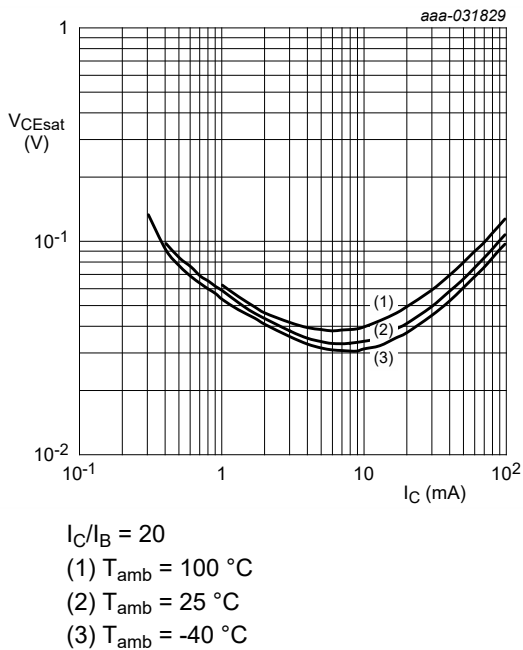


Fig. 19. NHUMH9: Collector-emitter saturation voltage as a function of collector current; typical values

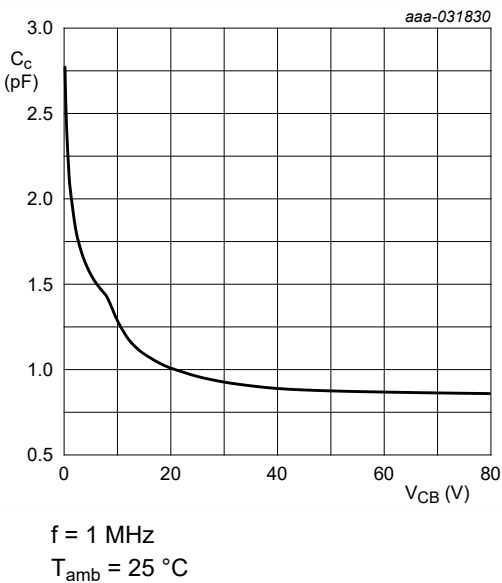


Fig. 20. NHUMH9: Collector capacitance as a function of collector-base voltage; typical values

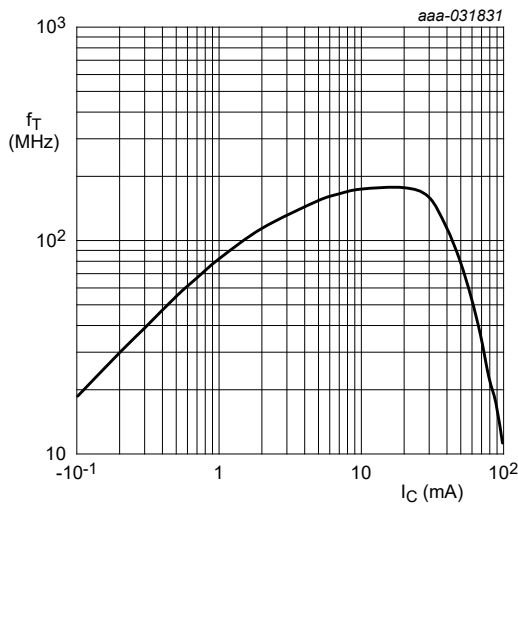


Fig. 21. Transition frequency as a function of collector current; typical values of built-in transistor

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)

$$R1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$

- Calculation of bias resistor ratio (R2/R1)

$$\frac{R2}{R1} = \frac{V(I_{I4}) - V(I_{I3})}{R1 \cdot (I_{I4} - I_{I3})} - 1$$

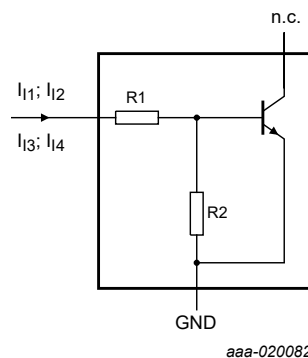


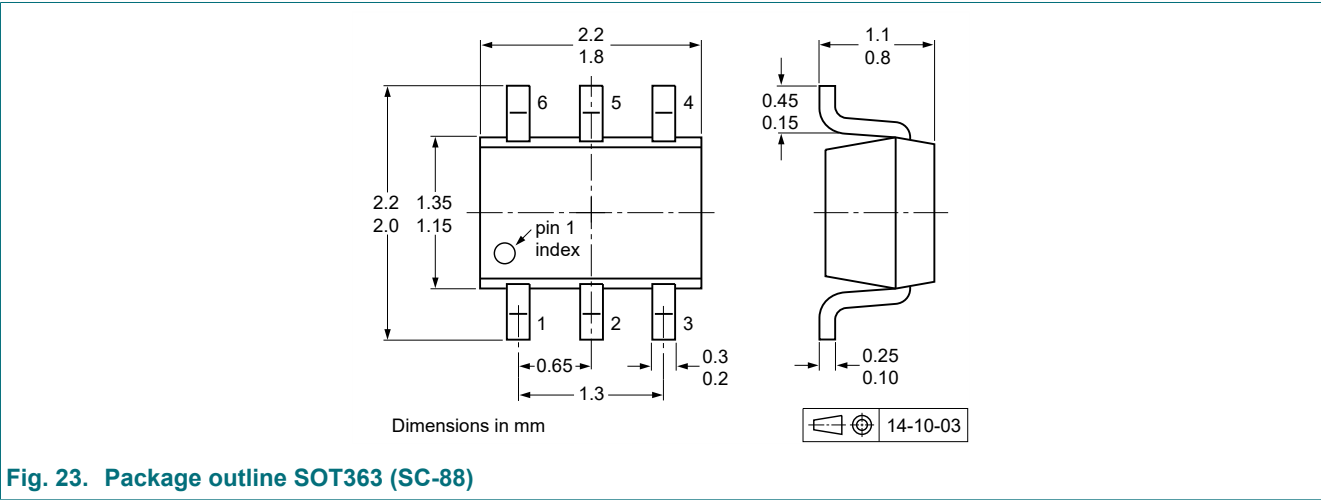
Fig. 22. NPN transistor: Resistor test circuit

Resistor test conditions

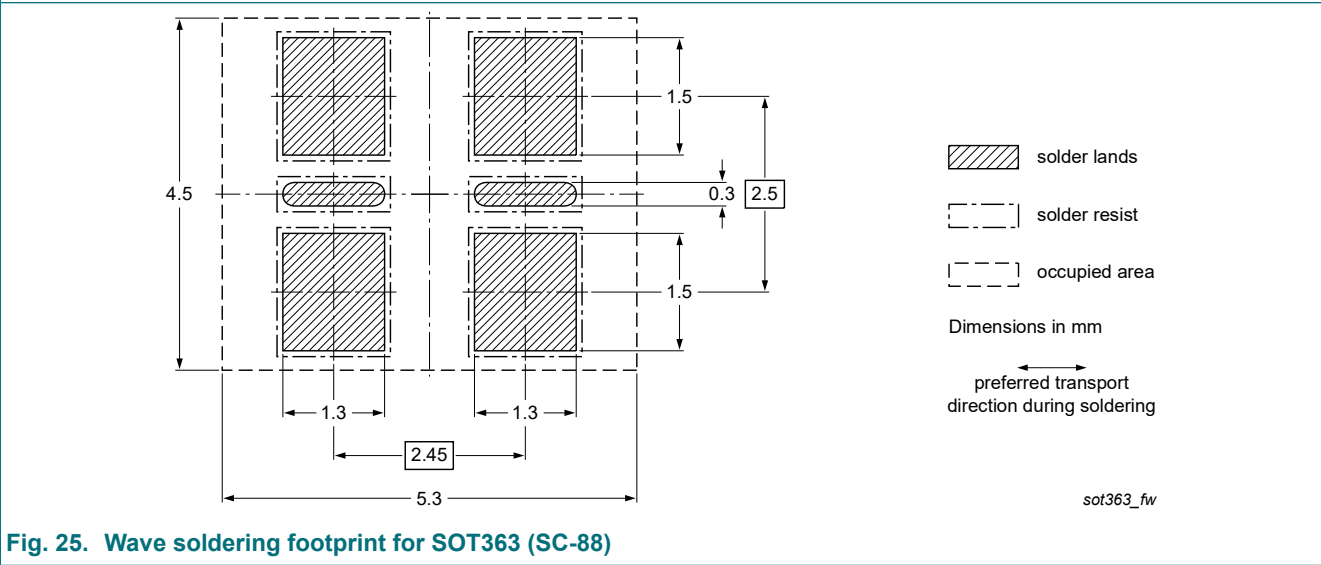
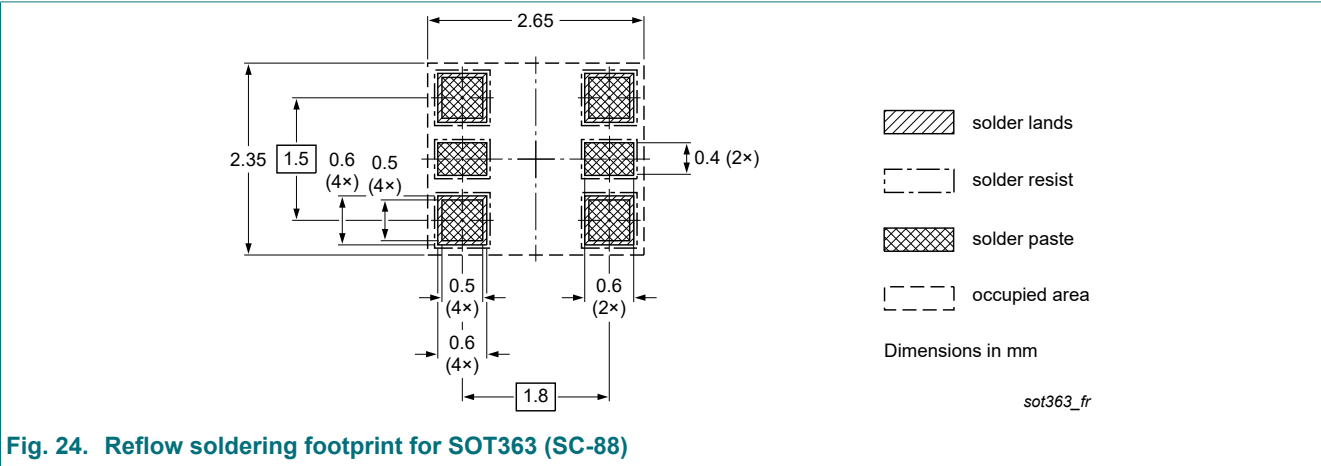
Table 9. Resistor test conditions

Type number	R1 (kΩ)	R2 (kΩ)	Test conditions			
			I _{I1}	I _{I2}	I _{I3}	I _{I4}
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



13. Soldering



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.

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Date of release: 24 July 2020