



NHUMD10/13/9 series

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

Rev. 1 — 24 July 2020

Product data sheet

1. General description

NPN/PNP 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		NPN/NPN complement:	PNP/PNP complement:
	k Ω	k Ω	Nexperia	JEITA		
NHUMD10	2.2	47	SOT363	SC-88	NHUMH10	NHUMB10
NHUMD13	4.7	47			NHUMH13	NHUMB13
NHUMD9	10	47			NHUMH9	NHUMB9

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 / BC856 series in digital applications
- Controlling IC inputs
- Switching loads

4. Quick reference data

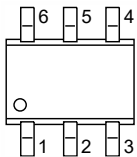
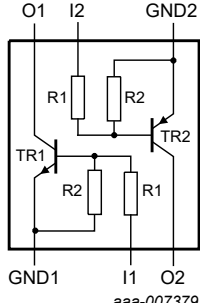
Table 2. Quick reference data

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor, for the PNP transistor with negative polarity						
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		Version
	Name	Description	
NHUMD10	SC-88	plastic surface-mounted package; 6 leads	SOT363
NHUMD13			
NHUMD9			

7. Marking

Table 5. Marking

Type number	Marking code [1]
NHUMD10	6P%
NHUMD13	6R%
NHUMD9	6N%

[1] % = placeholder for manufacturing site code

8. Limiting values

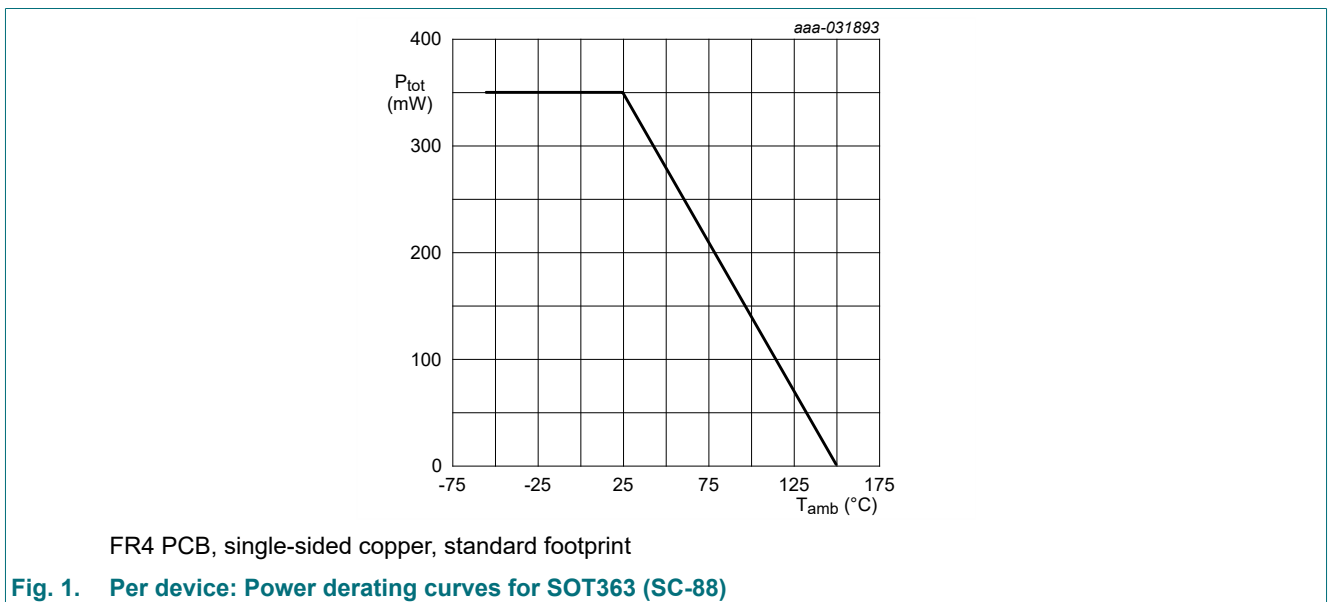
Table 6. Limiting values

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, for the PNP transistor with negative polarity					
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				
	NHUMD10, TR1 (NPN)		-7	+20	V
	NHUMD10, TR2 (PNP)		-20	+7	
	NHUMD13, TR1 (NPN)		-7	+30	V
	NHUMD13, TR2 (PNP)		-30	+7	V
	NHUMD9, TR1 (NPN)		-7	+40	V
NHUMD9, TR2 (PNP)		-40	+7	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.



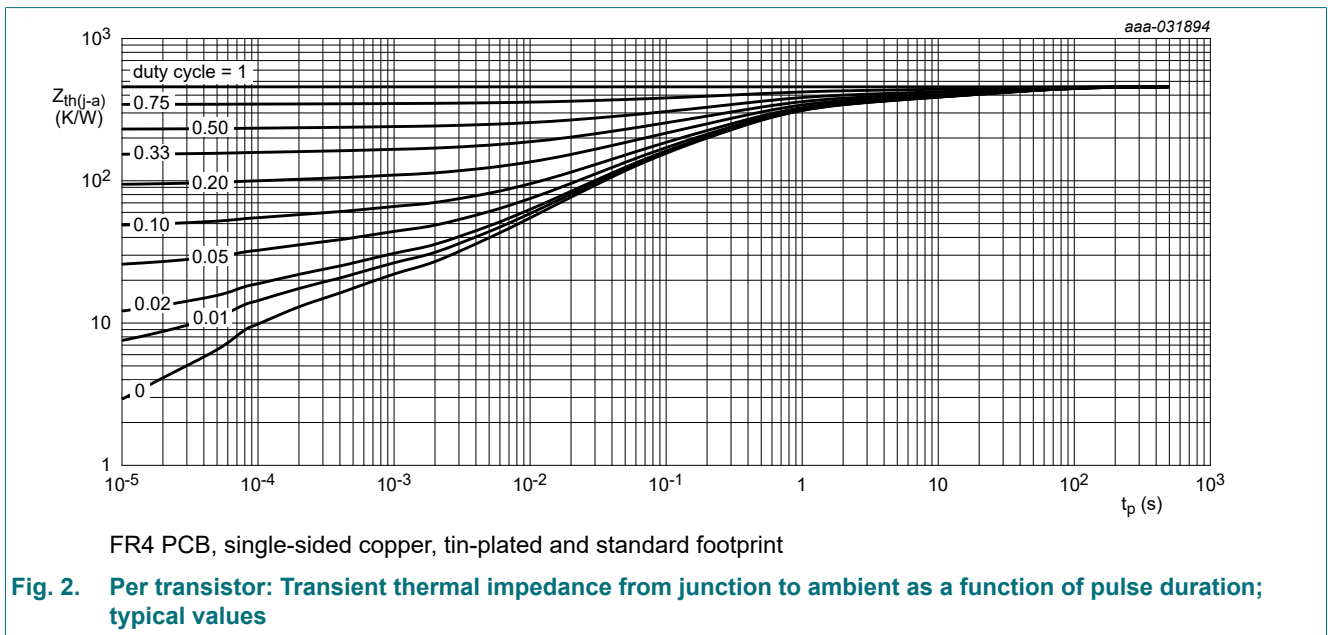
9. Thermal characteristics

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.



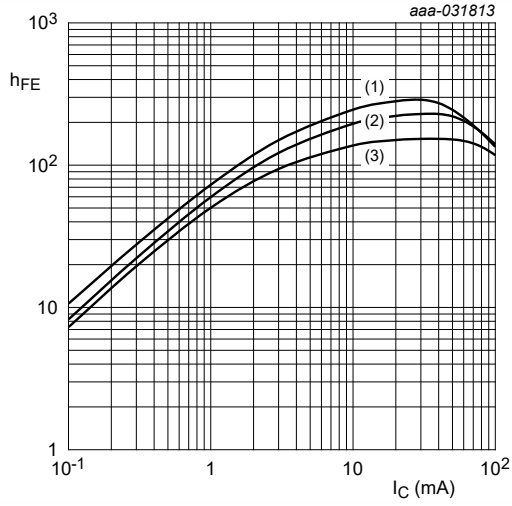
10. Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
Per transistor, for the PNP transistor with negative polarity							
$V_{(BR)CBO}$	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	
		$V_{CE} = 60\text{ V}; I_B = 0\text{ A}; T_J = 150\text{ }^{\circ}\text{C}$	-	-	5	μA	
I_{EBO}	emitter-base cut-off current						
	NHUMD10	$V_{EB} = 7\text{ V}; I_C = 0\text{ A}$	-	-	270	μA	
	NHUMD13		-	-	260	μA	
	NHUMD9		-	-	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						
	NHUMD10	$V_{CE} = 5\text{ V}; I_C = 100\text{ }\mu\text{A}$	-	595	500	mV	
	NHUMD13		-	625	500	mV	
	NHUMD9		-	690	500	mV	
$V_{I(on)}$	on-state input voltage						
	NHUMD10	$V_{CE} = 0.3\text{ V}; I_C = 10\text{ mA}$	1.2	0.81	-	V	
	NHUMD13		1.4	0.95	-	V	
	NHUMD9		1.6	1.22	-	V	
R1	bias resistor 1 (input)						
	NHUMD10	[1]	1.54	2.2	2.86	k Ω	
	NHUMD13		3.3	4.7	6.1	k Ω	
	NHUMD9		7	10	13	k Ω	
R2/R1	bias resistor ratio						
	NHUMD10	[1]	17	21	26		
	NHUMD13		8	10	12		
	NHUMD9		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]			
	TR1 (NPN)			-	170	-	MHz
	TR2 (PNP)			-	150	-	MHz
C_C	collector capacitance		$V_{CB} = 10\text{ V}; I_E = i_e = 0\text{ A}; f = 1\text{ MHz}$				
	TR1 (NPN)			-	-	2.5	pF
	TR2 (PNP)			-	-	3	pF

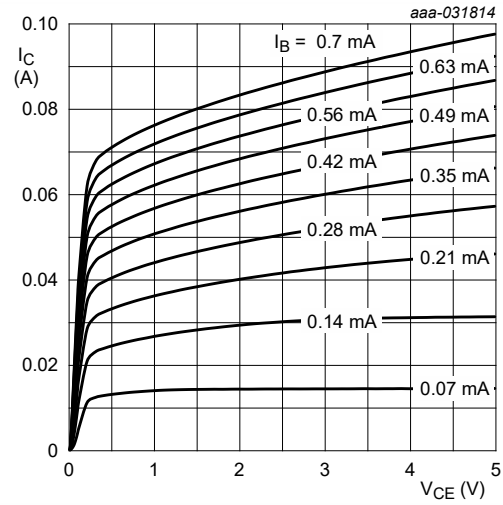
[1] See section "Test information" for resistor calculation and test conditions

[2] Characteristics of built-in transistor



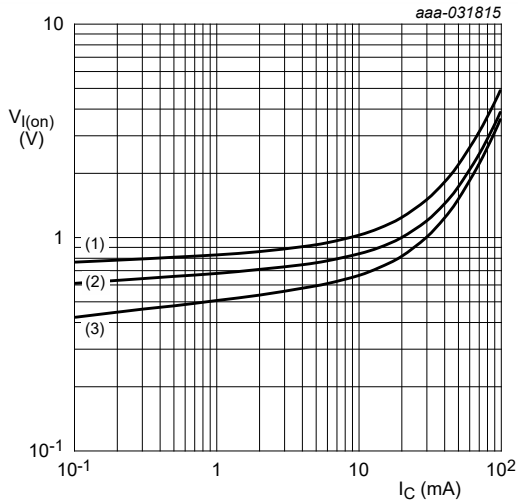
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 3. NHUMD10, TR1 (NPN): DC current gain as a function of collector current; typical values



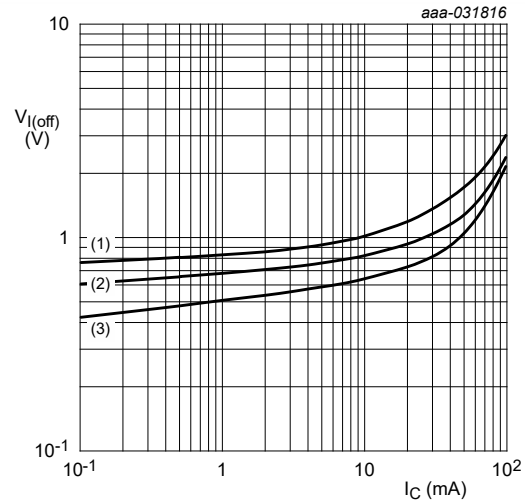
$T_{amb} = 25\text{ °C}$

Fig. 4. NHUMD10, TR1 (NPN): Collector current as a function of collector-emitter voltage; typical values



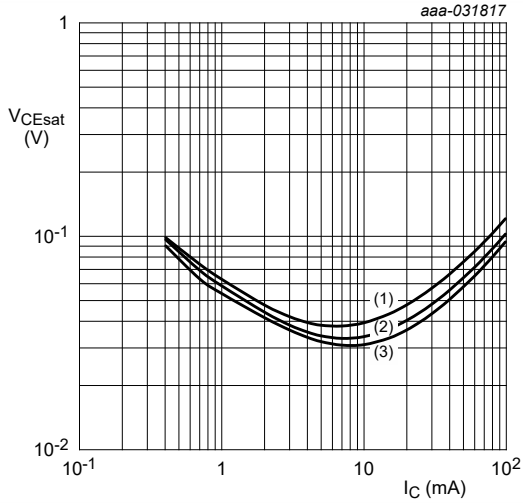
$V_{CE} = 0.3\text{ V}$
 (1) $T_{amb} = -40\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = 100\text{ °C}$

Fig. 5. NHUMD10, TR1 (NPN): On-state input voltage as a function of collector current; typical values



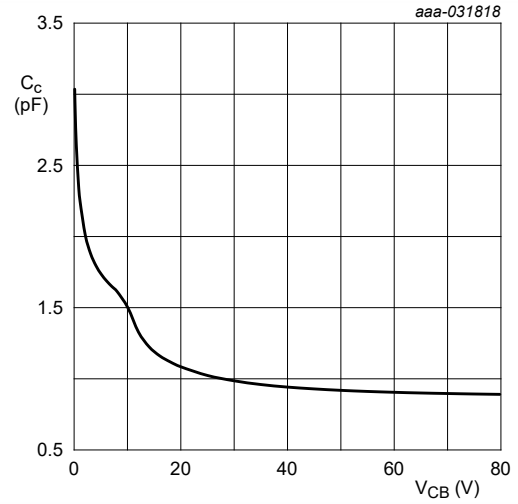
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = -40\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = 100\text{ °C}$

Fig. 6. NHUMD10, TR1 (NPN): Off-state input voltage as a function of collector current; typical values



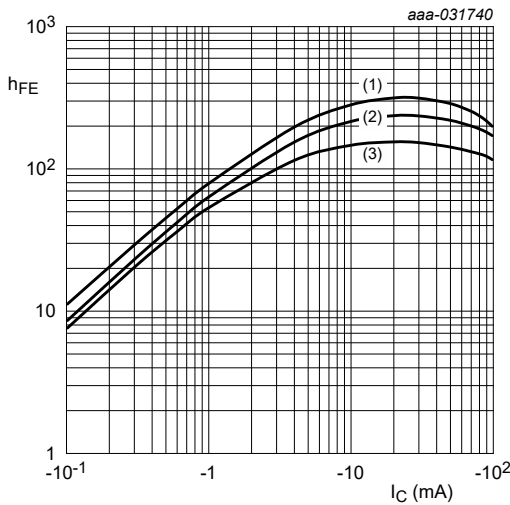
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 7. NHUMD10, TR1 (NPN): Collector-emitter saturation voltage as a function of collector current; typical values



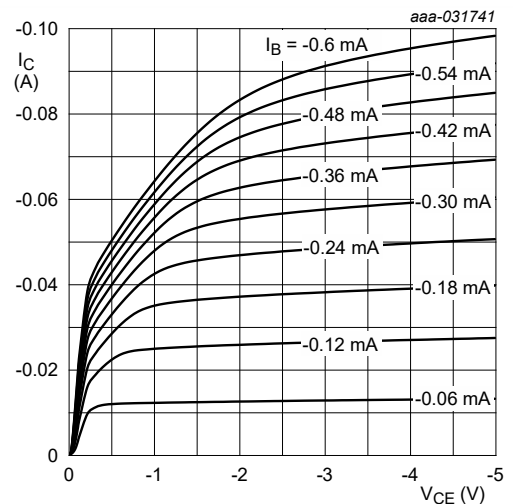
$f = 1\text{ MHz}$
 $T_{amb} = 25\text{ °C}$

Fig. 8. NHUMD10, TR1 (NPN): Collector capacitance as a function of collector-base voltage; typical values



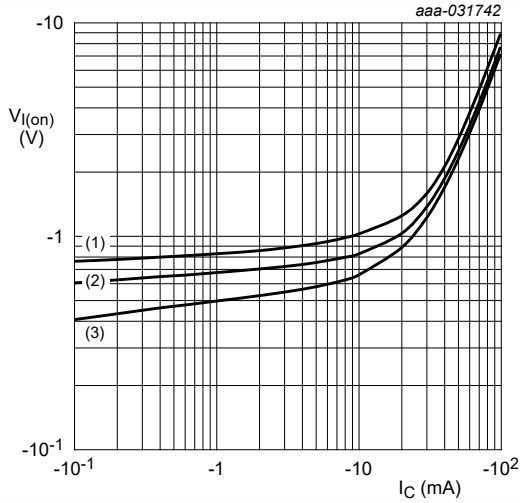
$V_{CE} = -5\text{ V}$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 9. NHUMD10, TR2 (PNP): DC current gain as a function of collector current; typical values



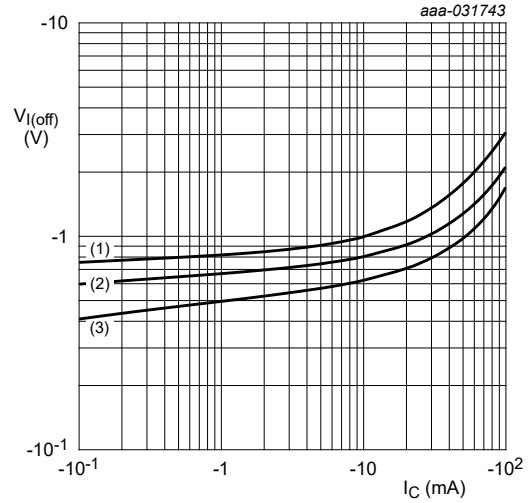
$T_{amb} = 25\text{ °C}$

Fig. 10. NHUMD10, TR2 (PNP): Collector current as a function of collector-emitter voltage; typical values



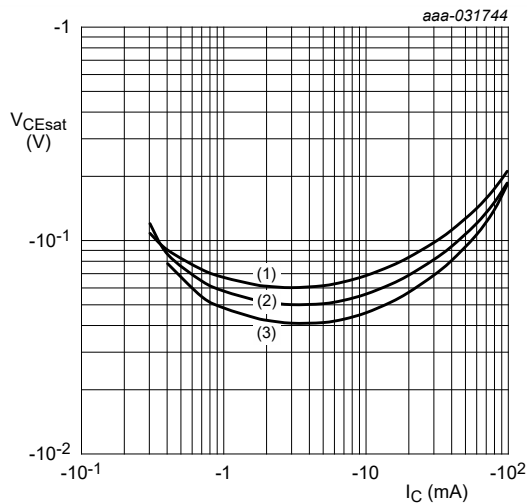
$V_{CE} = -0.3 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 11. NHUMD10, TR2 (PNP): On-state input voltage as a function of collector current; typical values



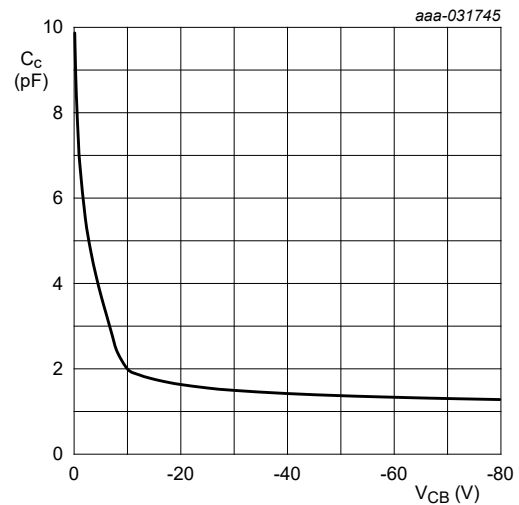
$V_{CE} = -5 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 12. NHUMD10, TR2 (PNP): Off-state input voltage as a function of collector current; typical values



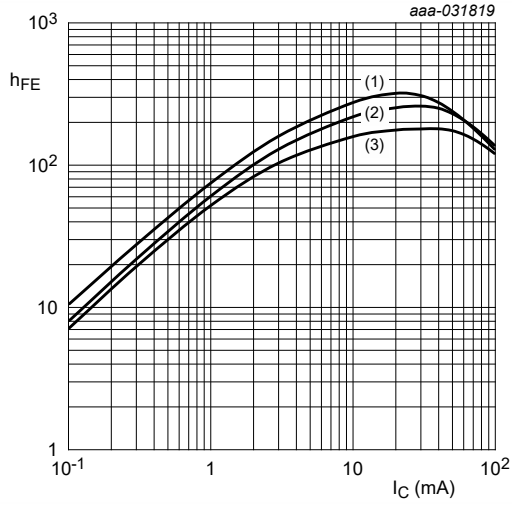
$I_C/I_B = 20$
 (1) $T_{amb} = 100 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = -40 \text{ }^\circ\text{C}$

Fig. 13. NHUMD10, TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values



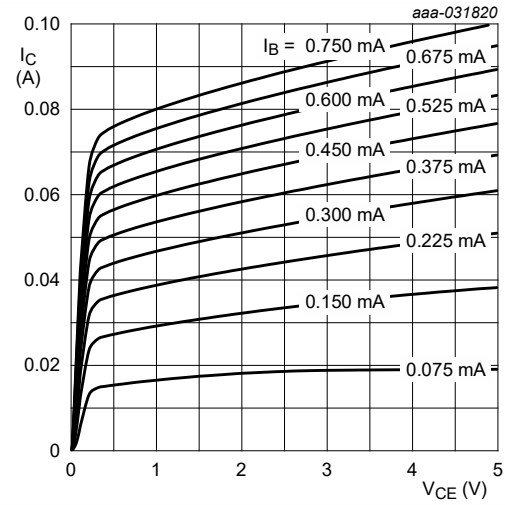
$f = 1 \text{ MHz}$
 $T_{amb} = 25 \text{ }^\circ\text{C}$

Fig. 14. NHUMD10, TR2 (PNP): Collector capacitance as a function of collector-base voltage; typical values



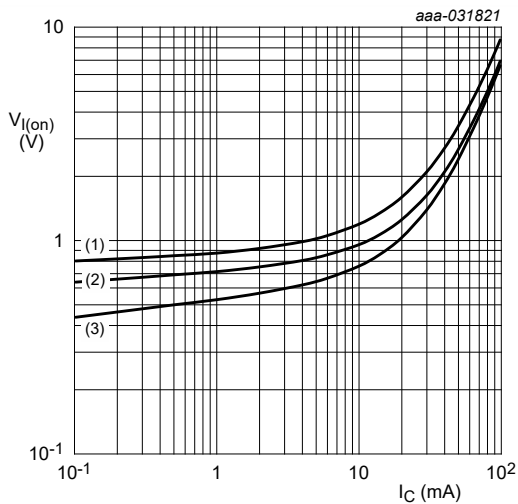
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 15. NHUMD13, TR1 (NPN): DC current gain as a function of collector current; typical values



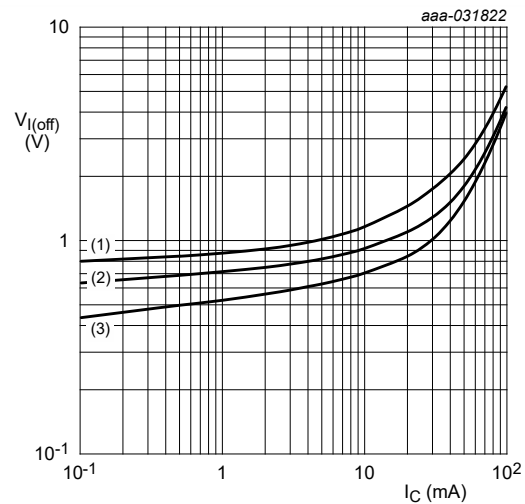
$T_{amb} = 25\text{ °C}$

Fig. 16. NHUMD13, TR1 (NPN): Collector current as a function of collector-emitter voltage; typical values



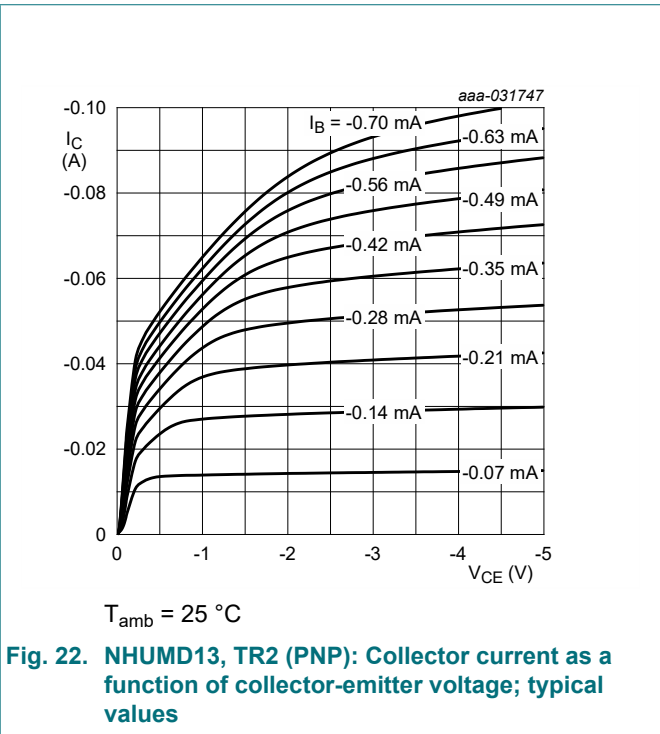
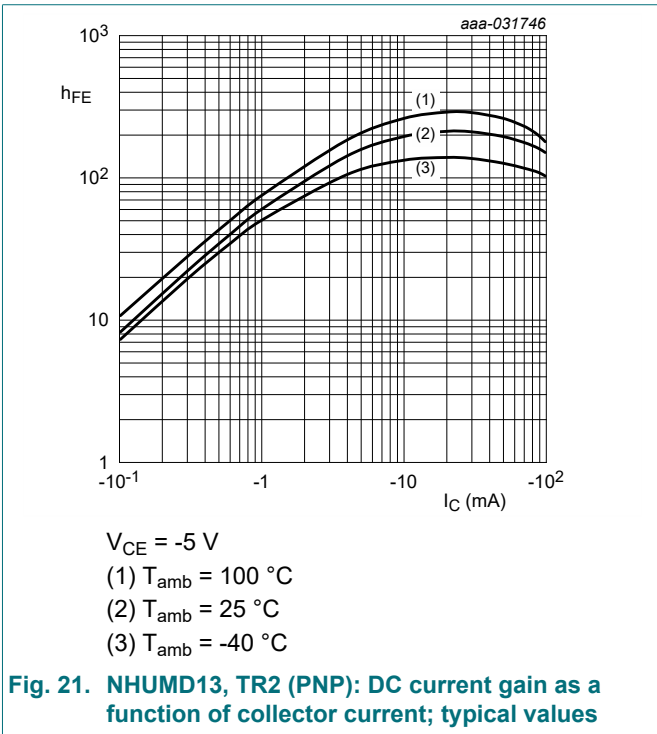
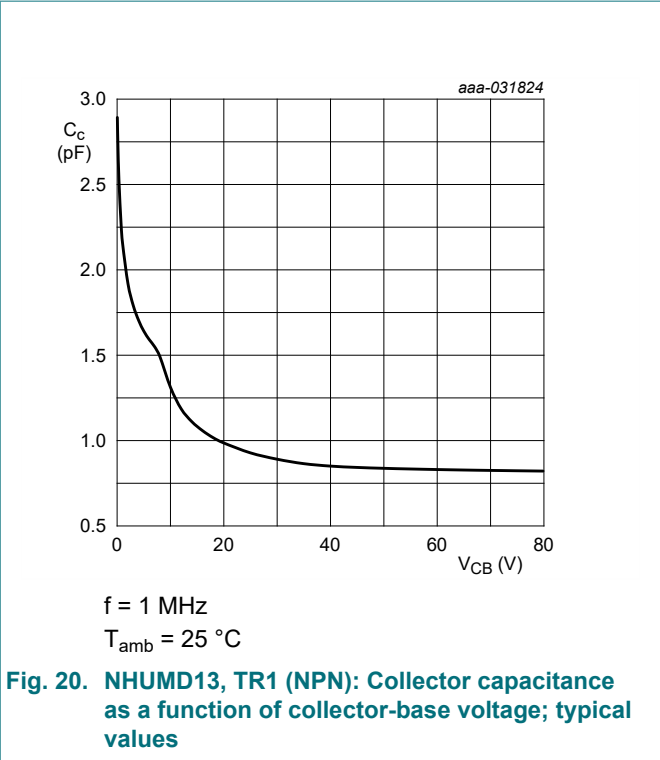
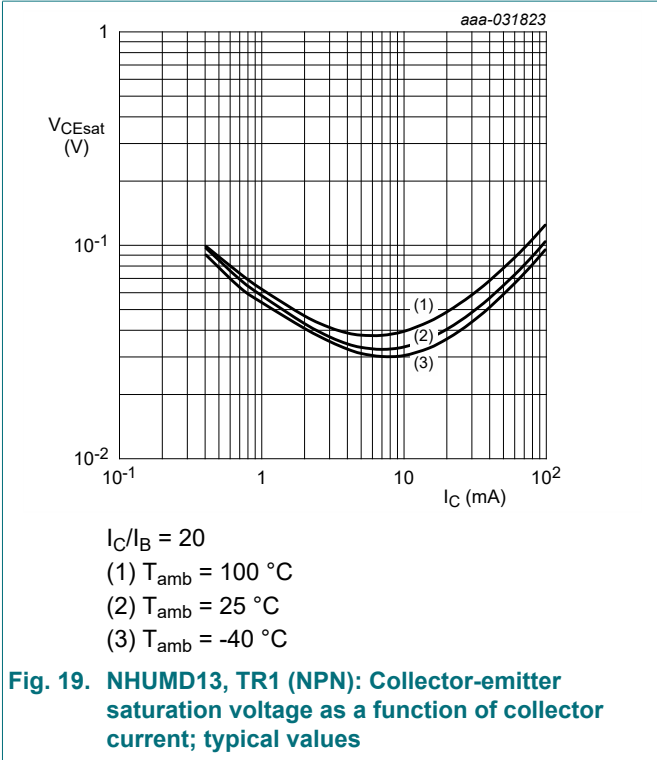
$V_{CE} = 0.3\text{ V}$
 (1) $T_{amb} = -40\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = 100\text{ °C}$

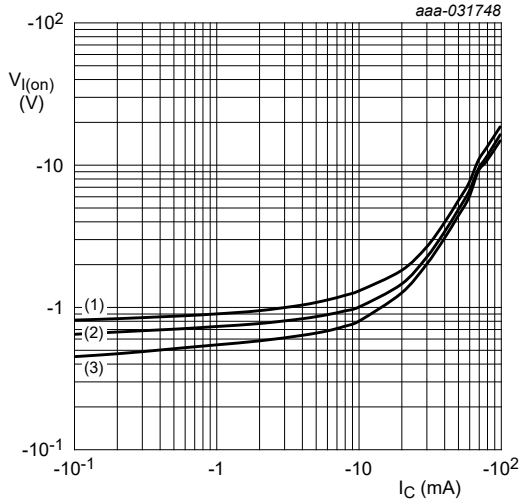
Fig. 17. NHUMD13, TR1 (NPN): On-state input voltage as a function of collector current; typical values



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

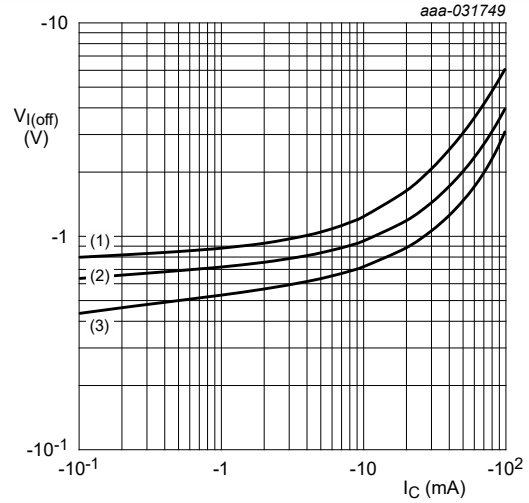
Fig. 18. NHUMD13, TR1 (NPN): Off-state input voltage as a function of collector current; typical values





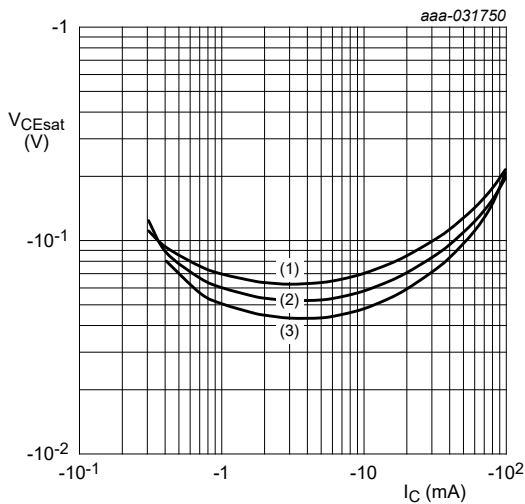
$V_{CE} = -0.3\text{ V}$
 (1) $T_{amb} = -40^\circ\text{C}$
 (2) $T_{amb} = 25^\circ\text{C}$
 (3) $T_{amb} = 100^\circ\text{C}$

Fig. 23. NHUMD13, TR2 (PNP): On-state input voltage as a function of collector current; typical values



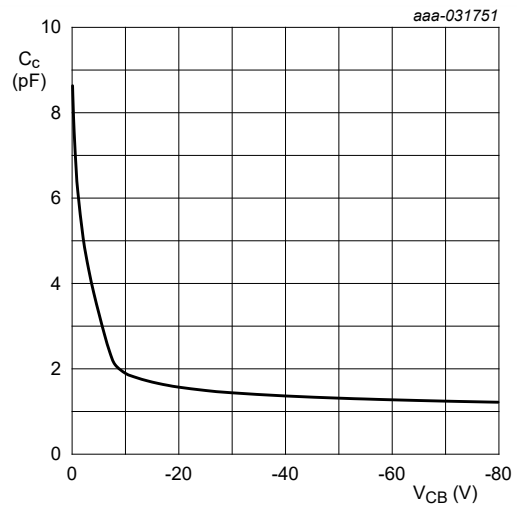
$V_{CE} = -5\text{ V}$
 (1) $T_{amb} = -40^\circ\text{C}$
 (2) $T_{amb} = 25^\circ\text{C}$
 (3) $T_{amb} = 100^\circ\text{C}$

Fig. 24. NHUMD13, TR2 (PNP): Off-state input voltage as a function of collector current; typical values



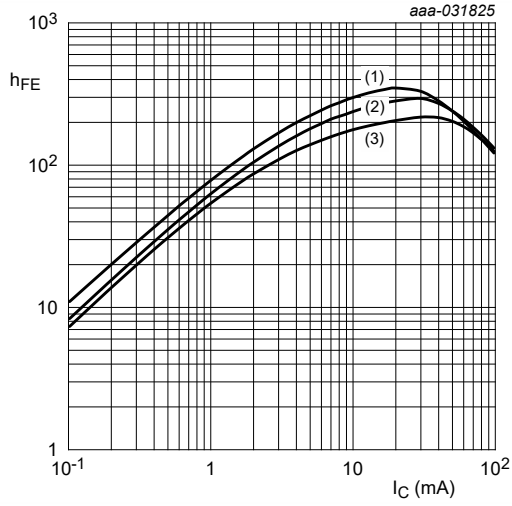
$I_C/I_B = 20$
 (1) $T_{amb} = 100^\circ\text{C}$
 (2) $T_{amb} = 25^\circ\text{C}$
 (3) $T_{amb} = -40^\circ\text{C}$

Fig. 25. NHUMD13, TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values



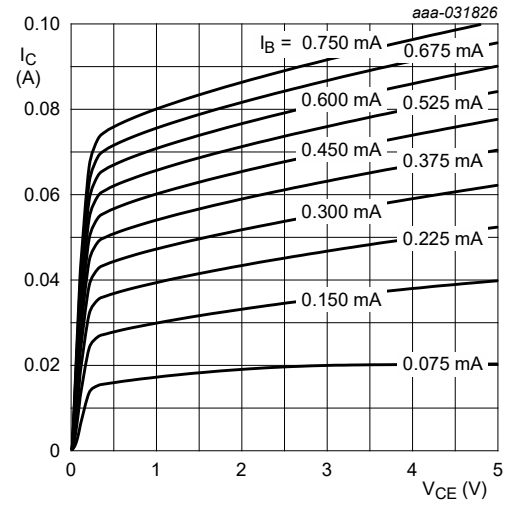
$f = 1\text{ MHz}$
 $T_{amb} = 25^\circ\text{C}$

Fig. 26. NHUMD13, TR2 (PNP): Collector capacitance as a function of collector-base voltage; typical values



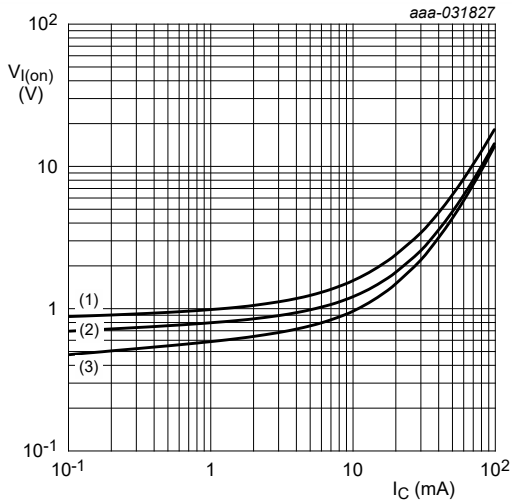
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 27. NHUMD9, TR1 (NPN): DC current gain as a function of collector current; typical values



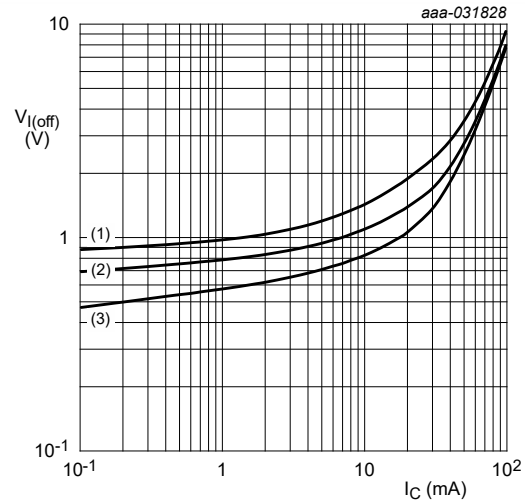
$T_{amb} = 25\text{ °C}$

Fig. 28. NHUMD9, TR1 (NPN): Collector current as a function of collector-emitter voltage; typical values



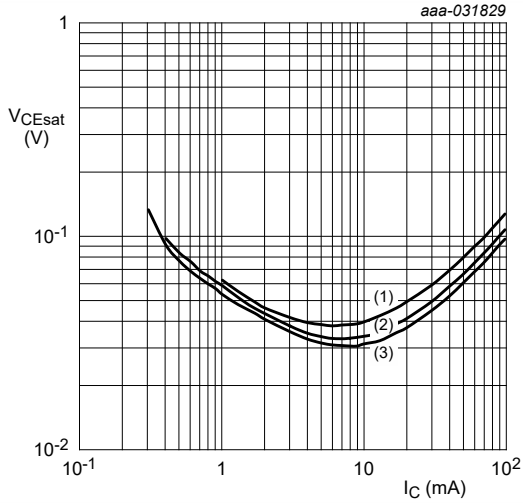
$V_{CE} = 0.3\text{ V}$
 (1) $T_{amb} = -40\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = 100\text{ °C}$

Fig. 29. NHUMD9, TR1 (NPN): On-state input voltage as a function of collector current; typical values



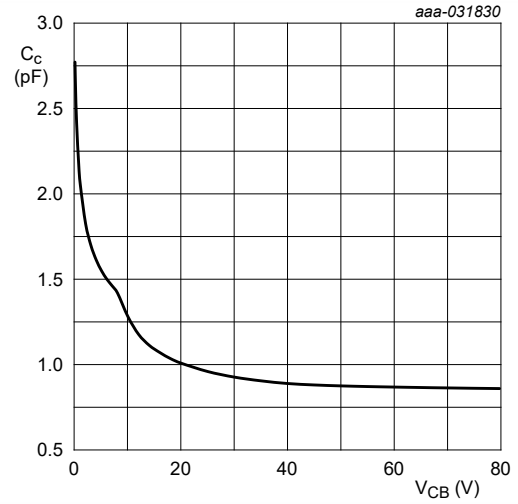
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = -40\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = 100\text{ °C}$

Fig. 30. NHUMD9, TR1 (NPN): Off-state input voltage as a function of collector current; typical values



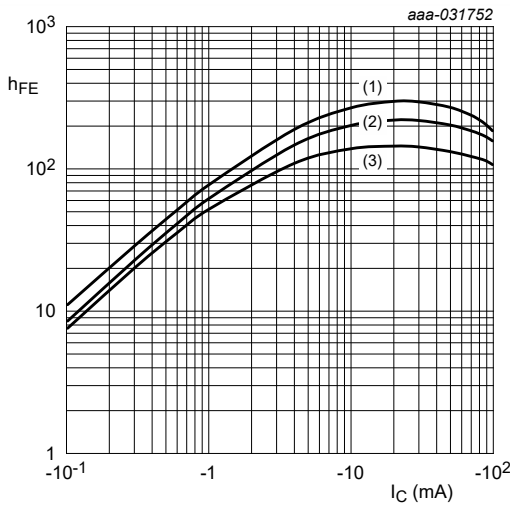
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 31. NHUMD9, TR1 (NPN): Collector-emitter saturation voltage as a function of collector current; typical values



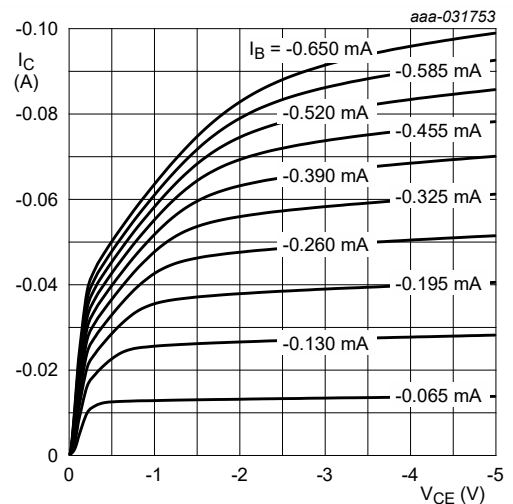
$f = 1\text{ MHz}$
 $T_{amb} = 25\text{ °C}$

Fig. 32. NHUMD9, TR1 (NPN): Collector capacitance as a function of collector-base voltage; typical values



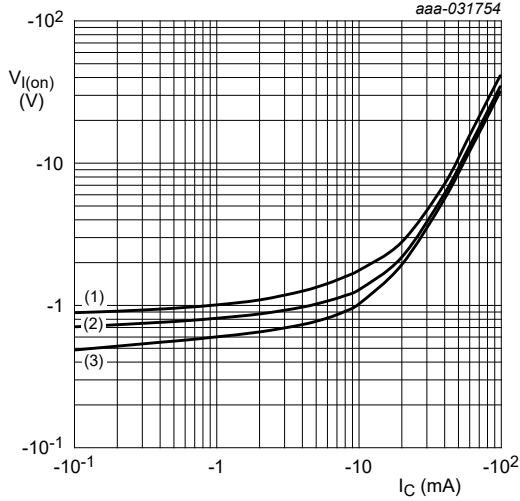
$V_{CE} = -5\text{ V}$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 33. NHUMD9, TR2 (PNP): DC current gain as a function of collector current; typical values



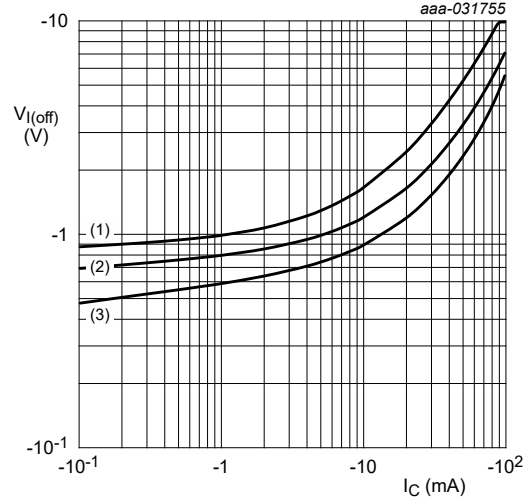
$T_{amb} = 25\text{ °C}$

Fig. 34. NHUMD9, TR2 (PNP): Collector current as a function of collector-emitter voltage; typical values



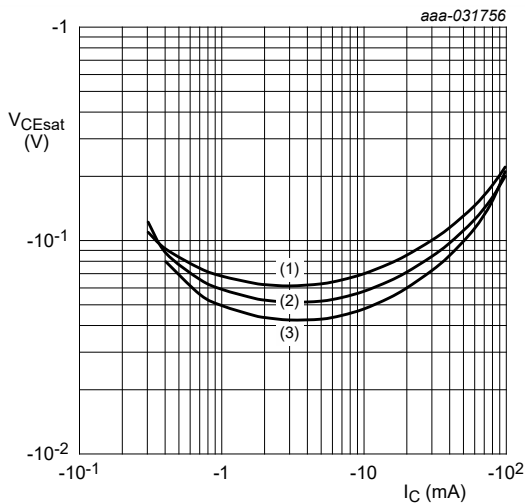
$V_{CE} = -0.3\text{ V}$
 (1) $T_{amb} = -40^\circ\text{C}$
 (2) $T_{amb} = 25^\circ\text{C}$
 (3) $T_{amb} = 100^\circ\text{C}$

Fig. 35. NHUMD9, TR2 (PNP): On-state input voltage as a function of collector current; typical values



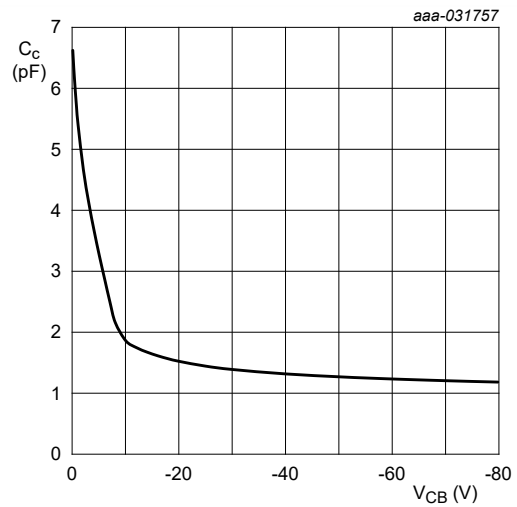
$V_{CE} = -5\text{ V}$
 (1) $T_{amb} = -40^\circ\text{C}$
 (2) $T_{amb} = 25^\circ\text{C}$
 (3) $T_{amb} = 100^\circ\text{C}$

Fig. 36. NHUMD9, TR2 (PNP): Off-state input voltage as a function of collector current; typical values



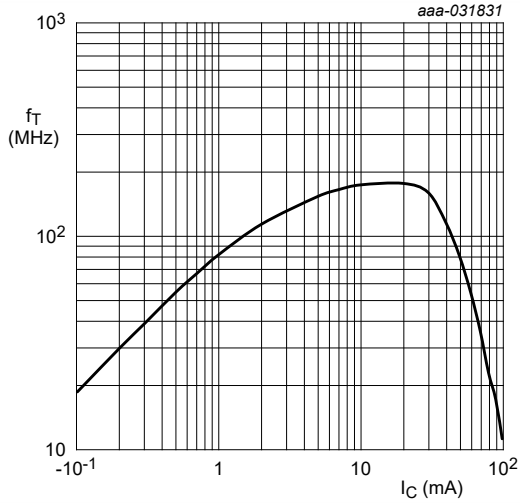
$I_C/I_B = 20$
 (1) $T_{amb} = 100^\circ\text{C}$
 (2) $T_{amb} = 25^\circ\text{C}$
 (3) $T_{amb} = -40^\circ\text{C}$

Fig. 37. NHUMD9, TR2 (PNP): Collector-emitter saturation voltage as a function of collector current; typical values



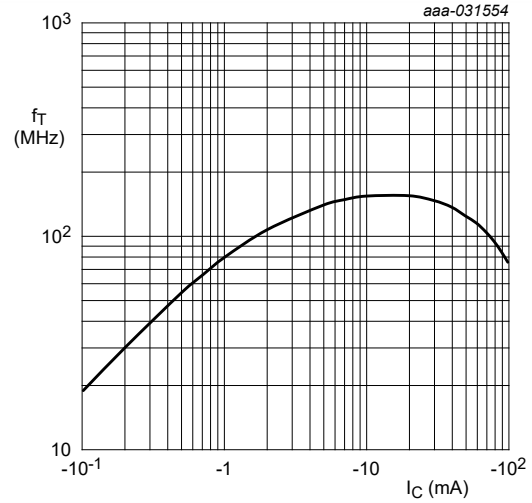
$f = 1\text{ MHz}$
 $T_{amb} = 25^\circ\text{C}$

Fig. 38. NHUMD9, TR2 (PNP): Collector capacitance as a function of collector-base voltage; typical values



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

Fig. 39. TR1 (NPN): Transition frequency as a function of collector current; typical values of built-in transistor



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

Fig. 40. TR2 (PNP): 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)

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

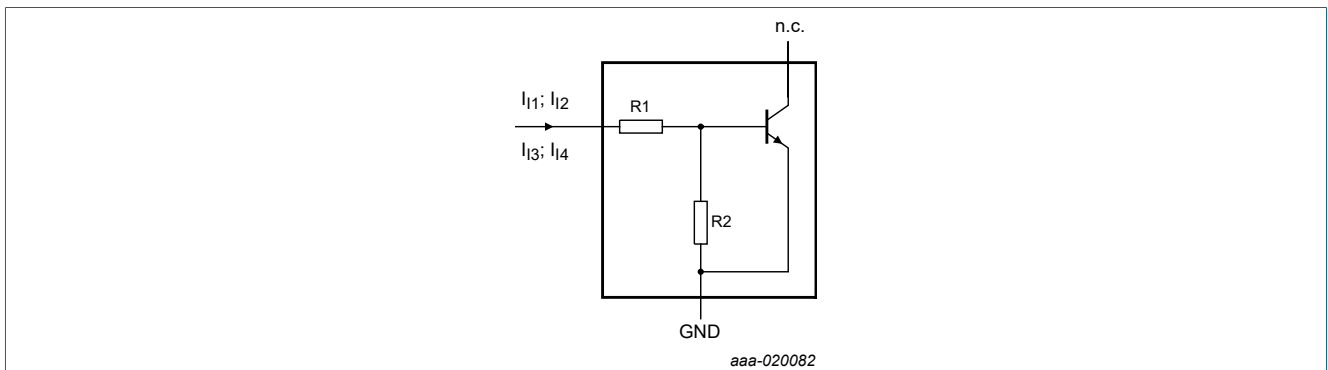


Fig. 41. TR1 (NPN): Resistor test circuit

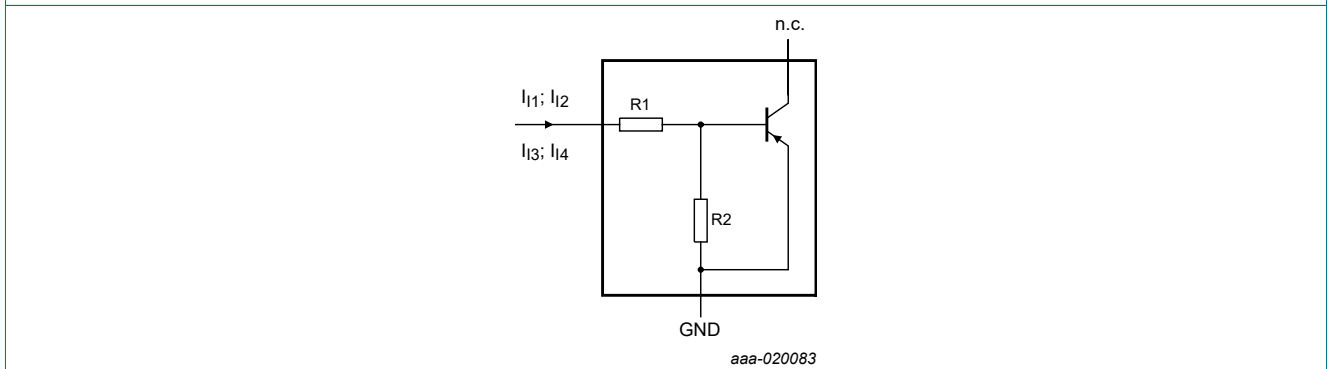


Fig. 42. TR2 (PNP): Resistor test circuit

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, for the PNP transistor with negative polarity						
NHUMD10	2.2	47	1.6 mA	2.4 mA	-55 μA	-105 μA
NHUMD13	4.7	47	1.2 mA	1.8 mA	-55 μA	-105 μA
NHUMD9	10	47	0.8 mA	1.1 mA	-55 μA	-105 μA

12. Package outline

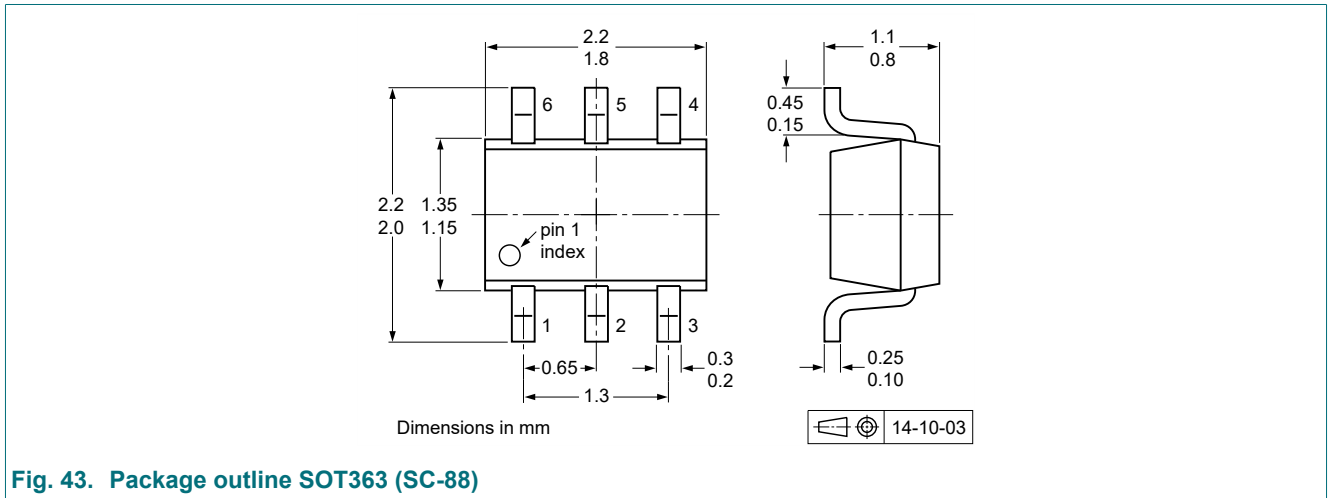


Fig. 43. Package outline SOT363 (SC-88)

13. Soldering

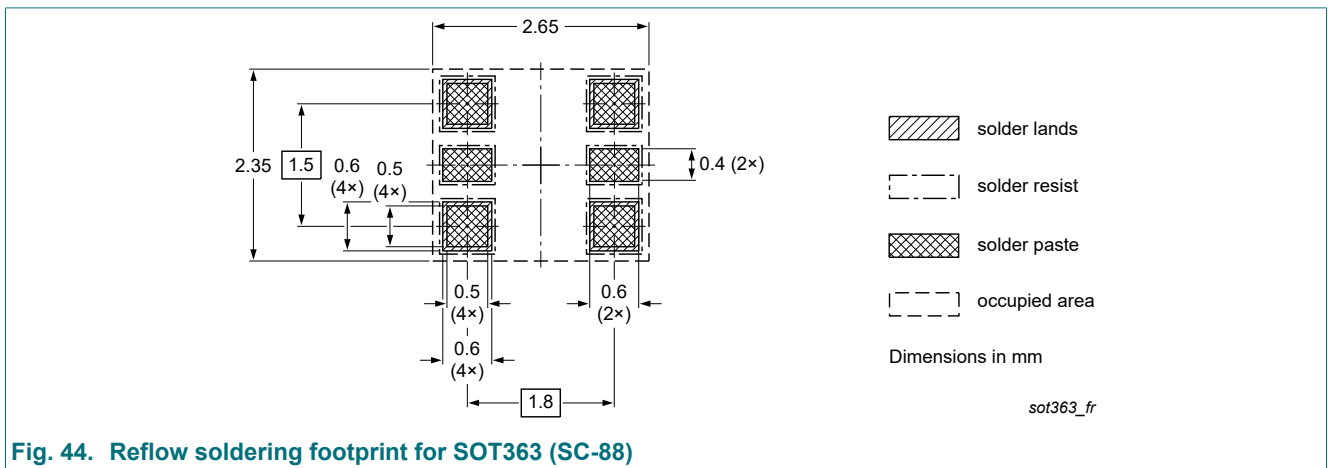


Fig. 44. Reflow soldering footprint for SOT363 (SC-88)

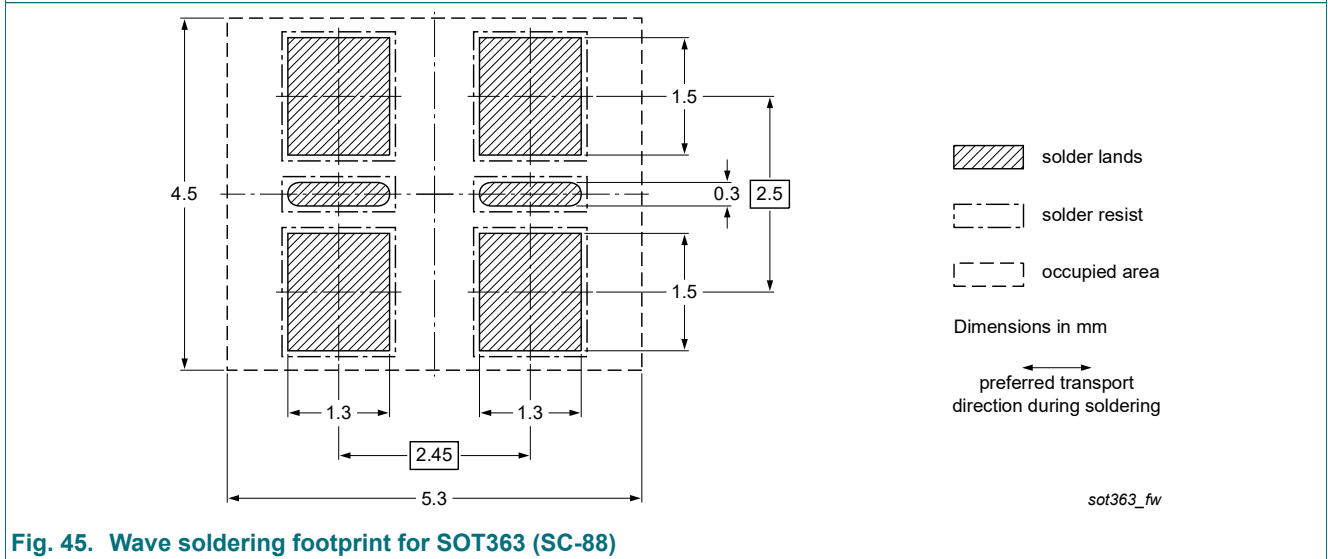


Fig. 45. Wave soldering footprint for SOT363 (SC-88)

14. Revision history

Table 10. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NHUMD10_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".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

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