



# NHUMH11/1/2 series

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

Rev. 1 — 22 July 2020

Product data sheet

## 1. General description

NPN/NPN 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		PNP/PNP complement:	NPN/PNP complement:
	k $\Omega$	k $\Omega$	Nexperia	JEITA		
NHUMH11	10	10	SOT363	SC-88	NHUMB11	NHUMD3
NHUMH1	22	22			NHUMB1	NHUMD2
NHUMH2	47	47			NHUMB2	NHUMD12

## 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

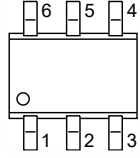
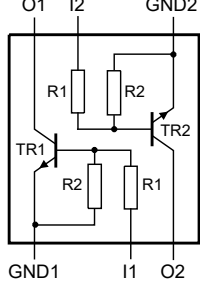
Table 2. Quick reference data

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<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
NHUMH11	SC-88	plastic surface-mounted package; 6 leads	SOT363
NHUMH1			
NHUMH2			

## 7. Marking

Table 5. Marking

Type number	Marking code [1]
NHUMH11	6F%
NHUMH1	6J%
NHUMH2	6L%

[1] % = placeholder for manufacturing site code

## 8. Limiting values

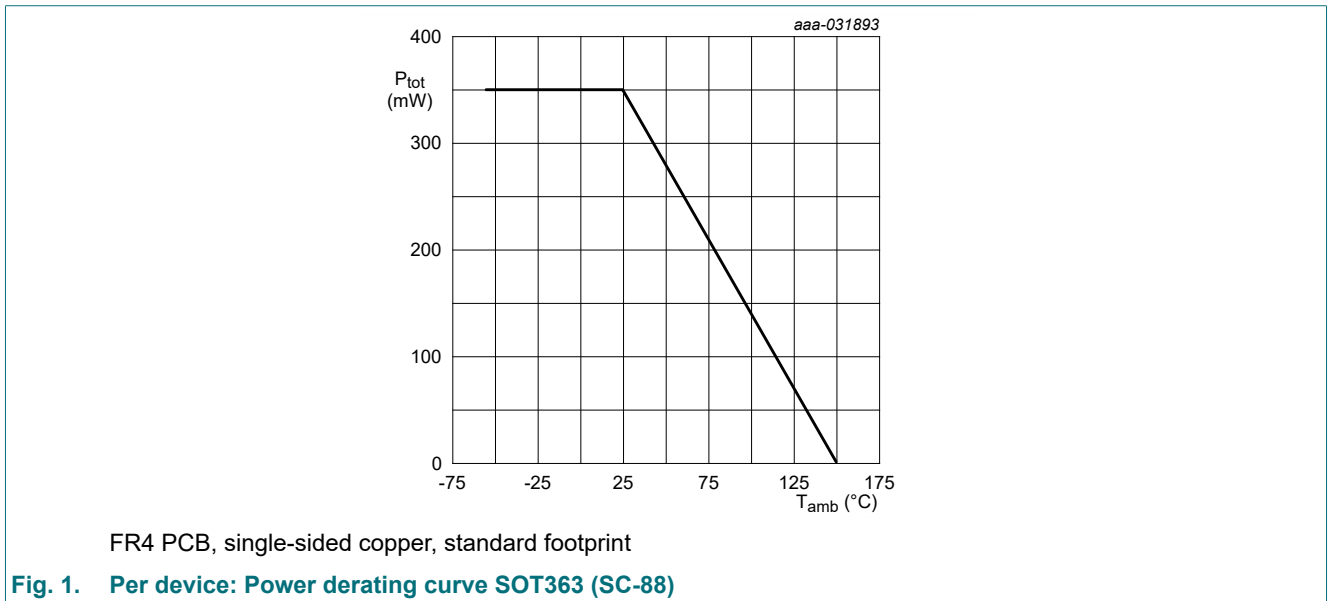
**Table 6. Limiting values**

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	-	10	V
$V_I$	input voltage				
	NHUMH11		-10	+40	V
	NHUMH1		-10	+60	V
	NHUMH2		-10	+80	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.



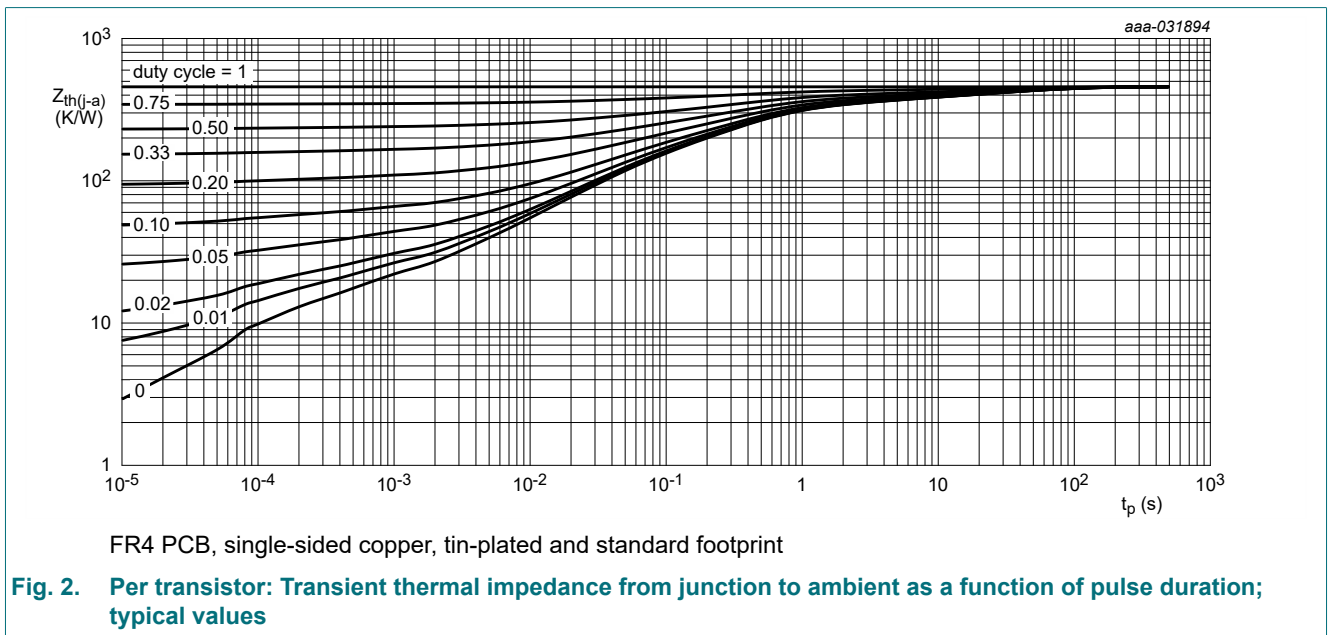
## 9. Thermal characteristics

**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	$I_C = 100\ \mu\text{A}; I_E = 0\ \text{A}$	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					
	NHUMH11	$V_{EB} = 7\ \text{V}; I_C = 0\ \text{A}$	-	-	600	$\mu\text{A}$
	NHUMH1		-	-	270	$\mu\text{A}$
	NHUMH2		-	-	130	$\mu\text{A}$
$h_{FE}$	DC current gain					
	NHUMH11	$V_{CE} = 5\ \text{V}; I_C = 10\ \text{mA}$	50	-	-	
	NHUMH1		70	-	-	
	NHUMH2		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	$V_{CE} = 5\ \text{V}; I_C = 100\ \mu\text{A}$	-	1.15	0.8	V
$V_{I(on)}$	on-state input voltage					
	NHUMH11	$V_{CE} = 0.3\ \text{V}; I_C = 10\ \text{mA}$	2.5	1.8	-	V
	NHUMH1		3	2.3	-	V
	NHUMH2		5	3.3	-	V
R1	bias resistor 1 (input)		[1]			
	NHUMH11		7	10	13	k $\Omega$
	NHUMH1		15.4	22	28.6	k $\Omega$
	NHUMH2		33	47	61	k $\Omega$
R2/R1	bias resistor ratio	[1]	0.8	1	1.2	
$f_T$	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

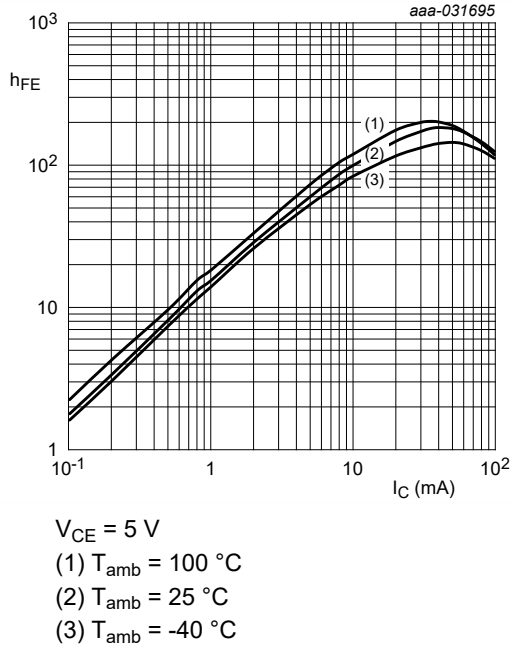


Fig. 3. NHUMH11: DC current gain as a function of collector current; typical values

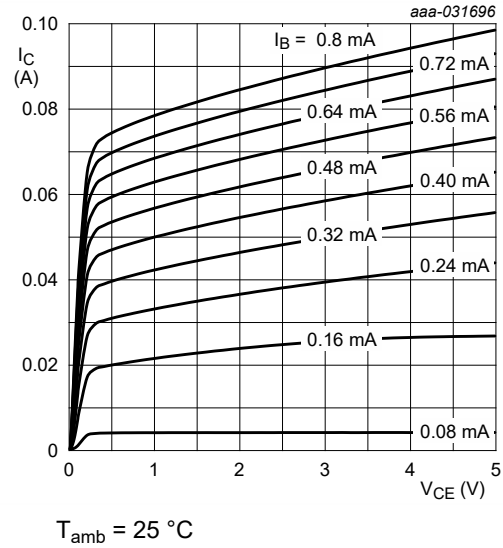


Fig. 4. NHUMH11: Collector current as a function of collector-emitter voltage; typical values

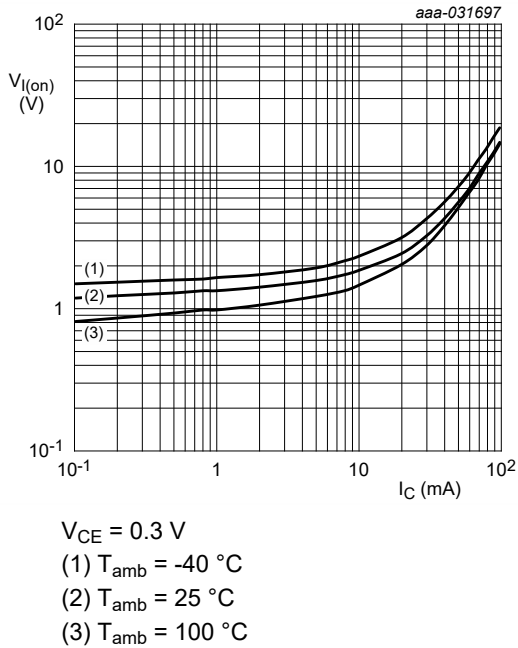


Fig. 5. NHUMH11: On-state input voltage as a function of collector current; typical values

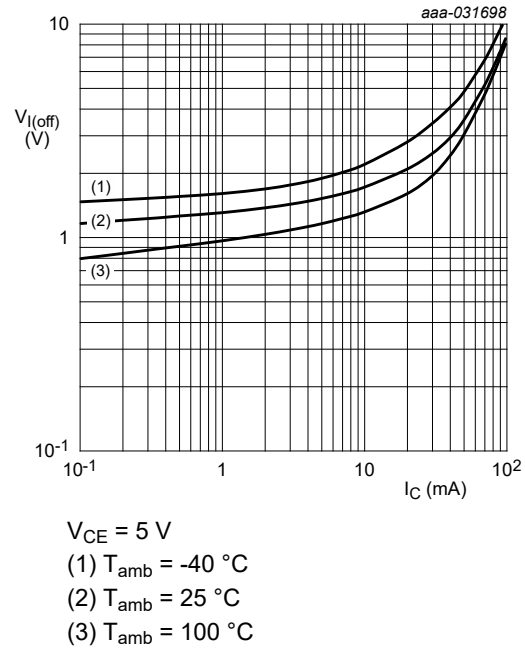
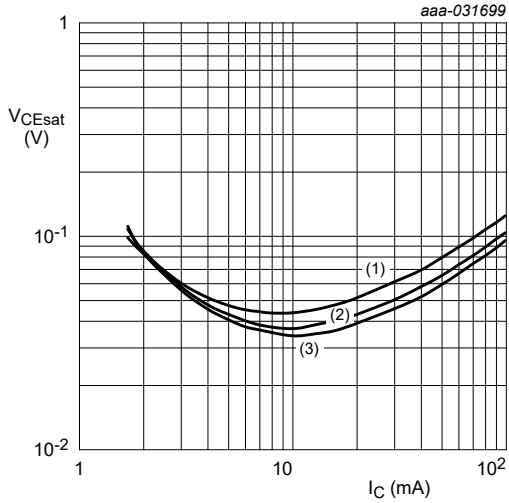
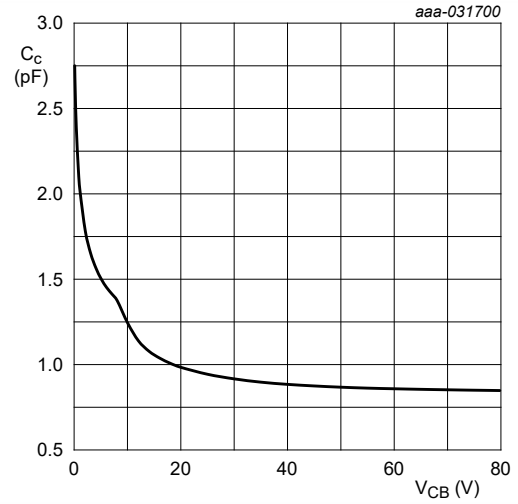


Fig. 6. NHUMH11: Off-state input voltage as a function of collector current; typical values



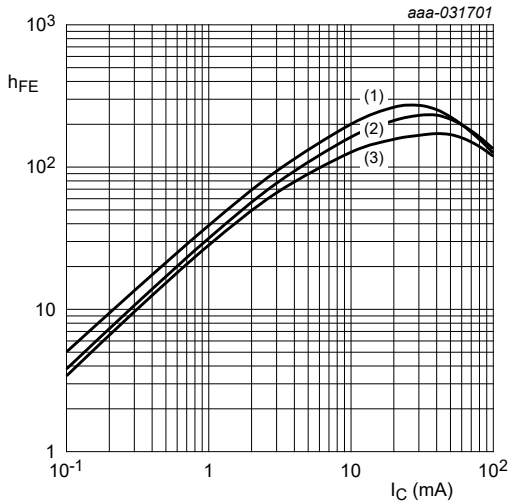
$I_C/I_B = 20$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

Fig. 7. NHUMH11: Collector-emitter saturation voltage as a function of collector current; typical values



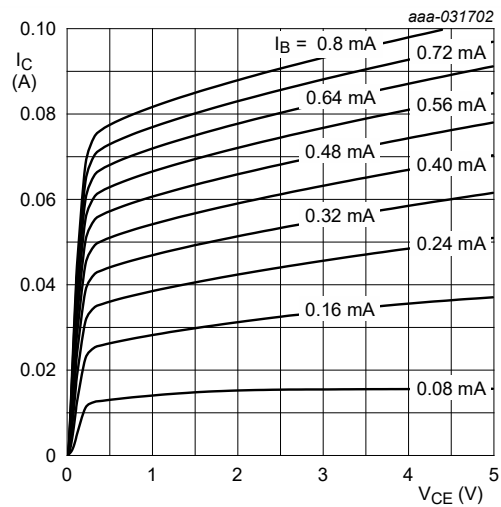
$f = 1\text{ MHz}$   
 $T_{amb} = 25\text{ °C}$

Fig. 8. NHUMH11: Collector capacitance as a function of collector-base voltage; typical values



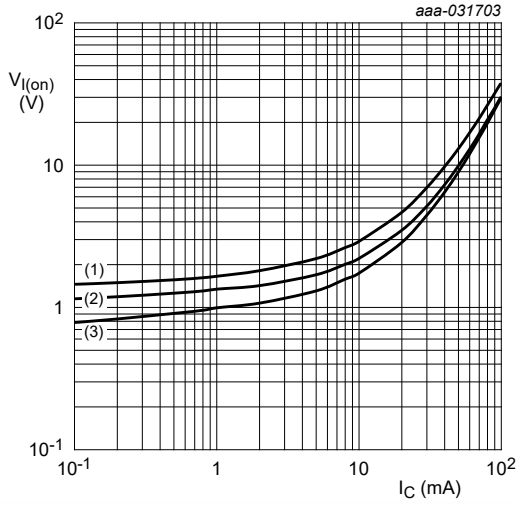
$V_{CE} = 5\text{ V}$   
 (1)  $T_{amb} = 100\text{ °C}$   
 (2)  $T_{amb} = 25\text{ °C}$   
 (3)  $T_{amb} = -40\text{ °C}$

Fig. 9. NHUMH11: DC current gain as a function of collector current; typical values



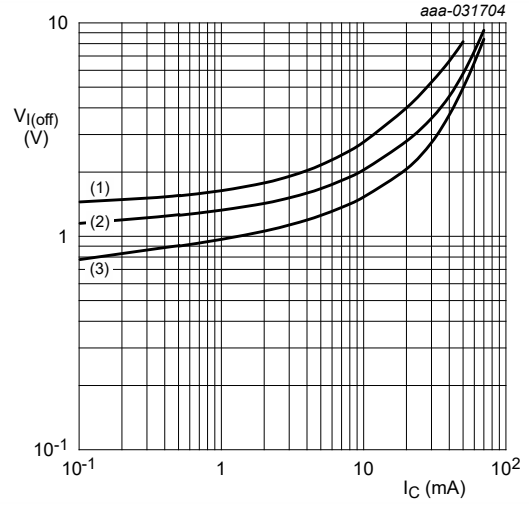
$T_{amb} = 25\text{ °C}$

Fig. 10. NHUMH11: Collector current as a function of collector-emitter voltage; typical values



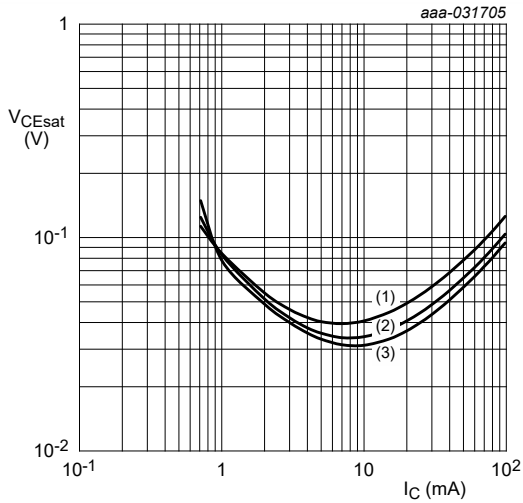
$V_{CE} = 0.3$  V  
 (1)  $T_{amb} = -40$  °C  
 (2)  $T_{amb} = 25$  °C  
 (3)  $T_{amb} = 100$  °C

**Fig. 11. NHUMH1: On-state input voltage as a function of collector current; typical values**



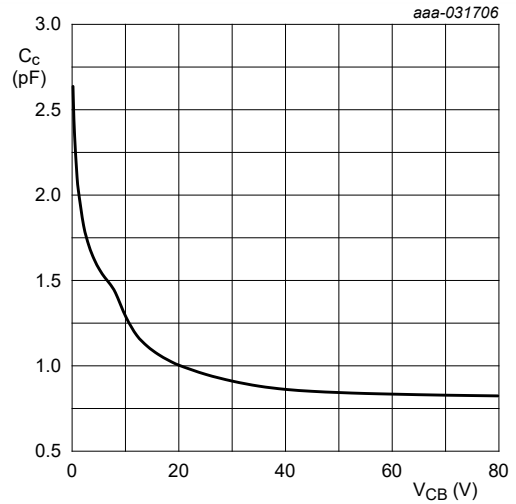
$V_{CE} = 5$  V  
 (1)  $T_{amb} = -40$  °C  
 (2)  $T_{amb} = 25$  °C  
 (3)  $T_{amb} = 100$  °C

**Fig. 12. NHUMH1: Off-state input voltage as a function of collector current; typical values**



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

**Fig. 13. NHUMH1: Collector-emitter saturation voltage as a function of collector current; typical values**



$f = 1$  MHz  
 $T_{amb} = 25$  °C

**Fig. 14. NHUMH1: Collector capacitance as a function of collector-base voltage; typical values**



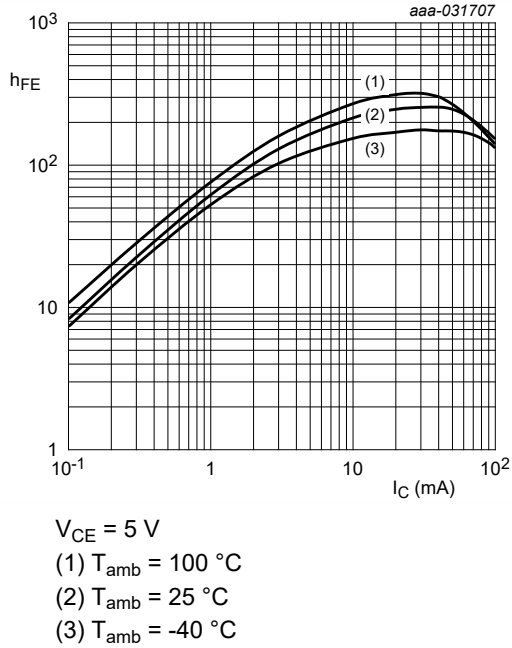


Fig. 15. NHUMH2: DC current gain as a function of collector current; typical values

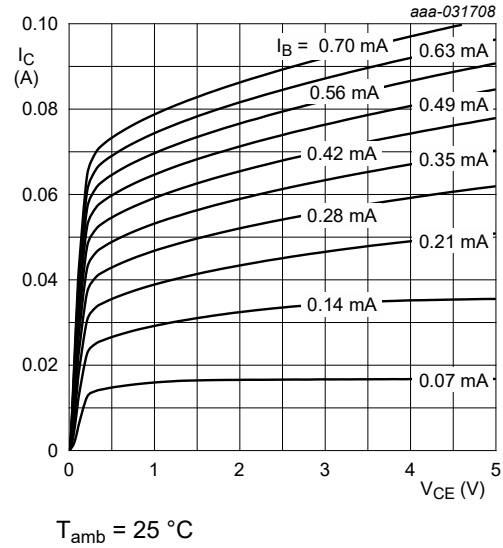


Fig. 16. NHUMH2: Collector current as a function of collector-emitter voltage; typical values

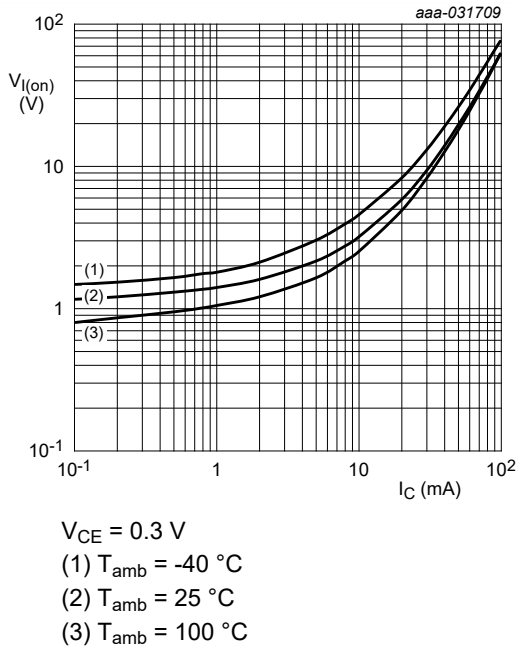


Fig. 17. NHUMH2: On-state input voltage as a function of collector current; typical values

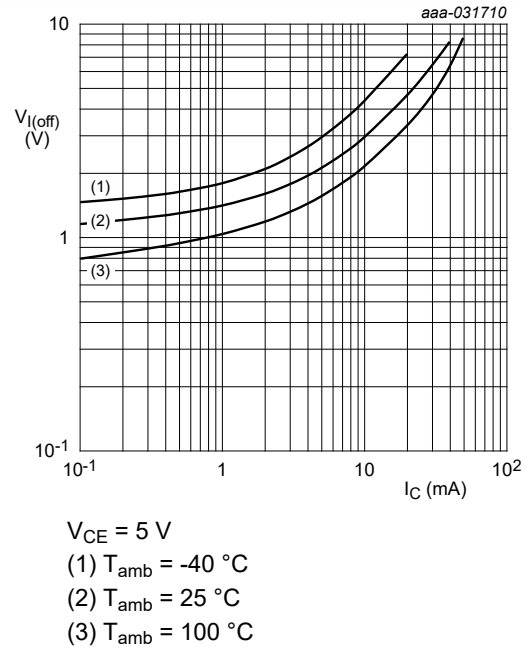
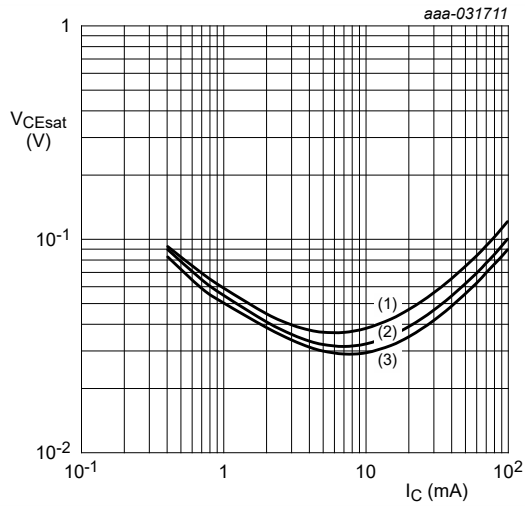


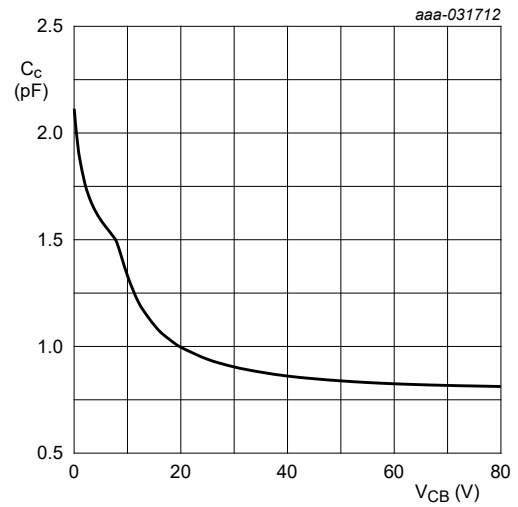
Fig. 18. NHUMH2: Off-state input voltage as a function of collector current; typical values



$I_C/I_B = 20$

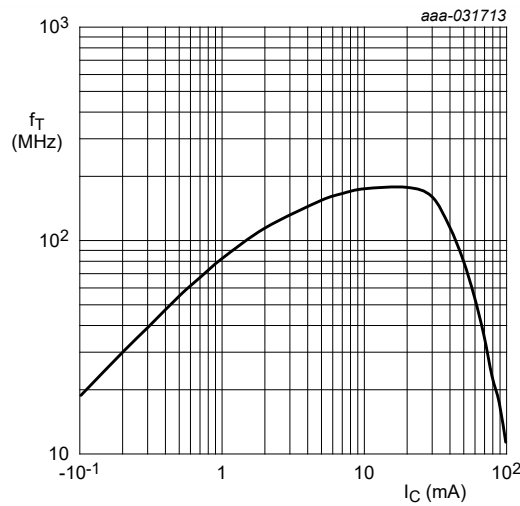
- (1)  $T_{amb} = 100\text{ °C}$
- (2)  $T_{amb} = 25\text{ °C}$
- (3)  $T_{amb} = -40\text{ °C}$

**Fig. 19. NHUMH2: Collector-emitter saturation voltage as a function of collector current; typical values**



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

**Fig. 20. NHUMH2: Collector capacitance as a function of collector-base voltage; typical values of built-in transistor**



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

**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)

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

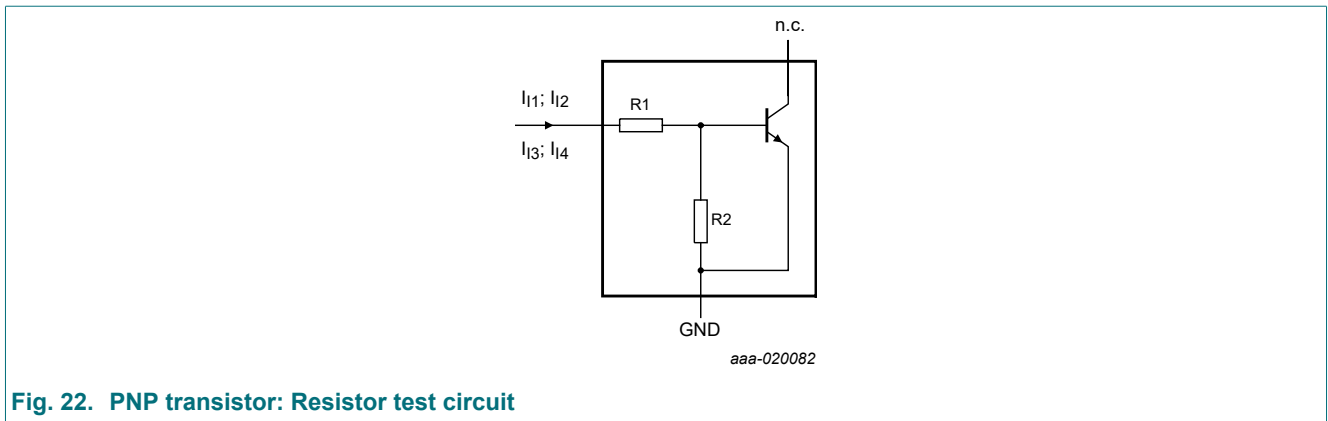


Fig. 22. PNP transistor: Resistor test circuit

### 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>						
NHUMH11	10	10	800 μA	1.1 mA	-350 μA	-450 μA
NHUMH1	22	22	550 μA	750 μA	-150 μA	-230 μA
NHUMH2	47	47	250 μA	350 μA	-55 μA	-105 μA

## 12. Package outline

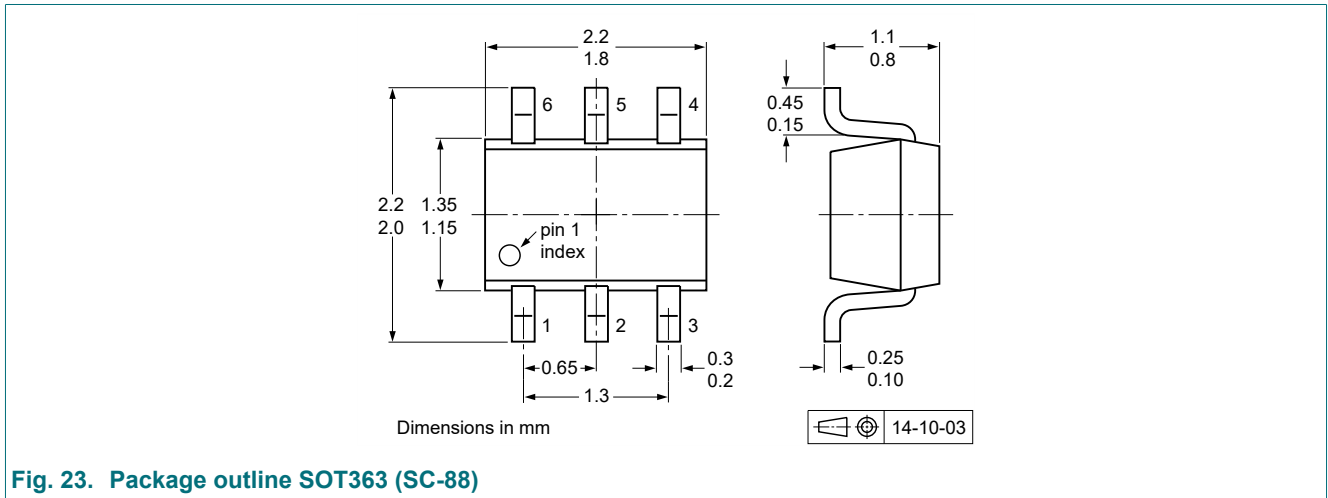


Fig. 23. Package outline SOT363 (SC-88)

## 13. Soldering

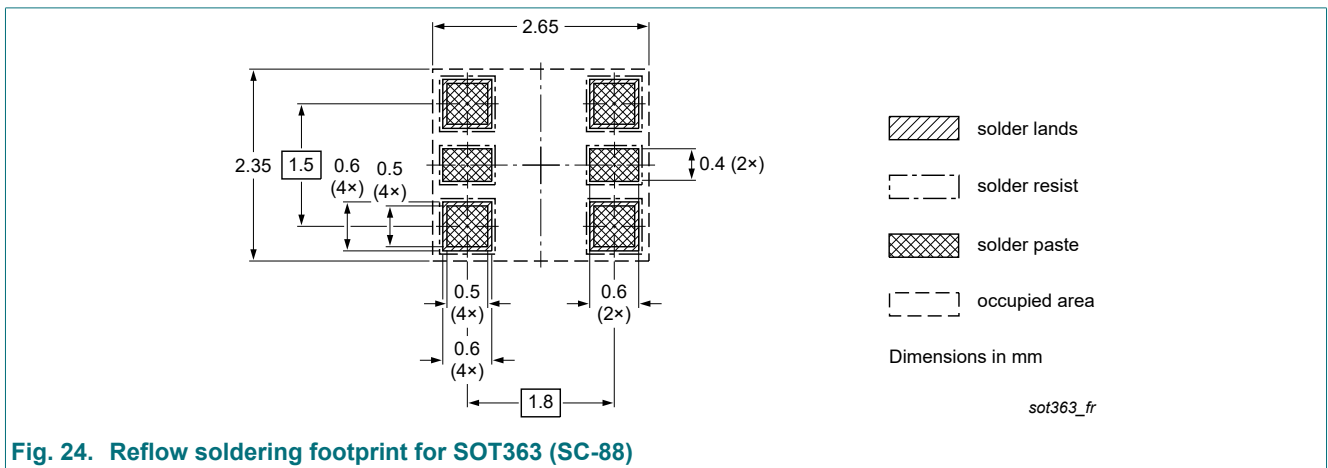


Fig. 24. Reflow soldering footprint for SOT363 (SC-88)

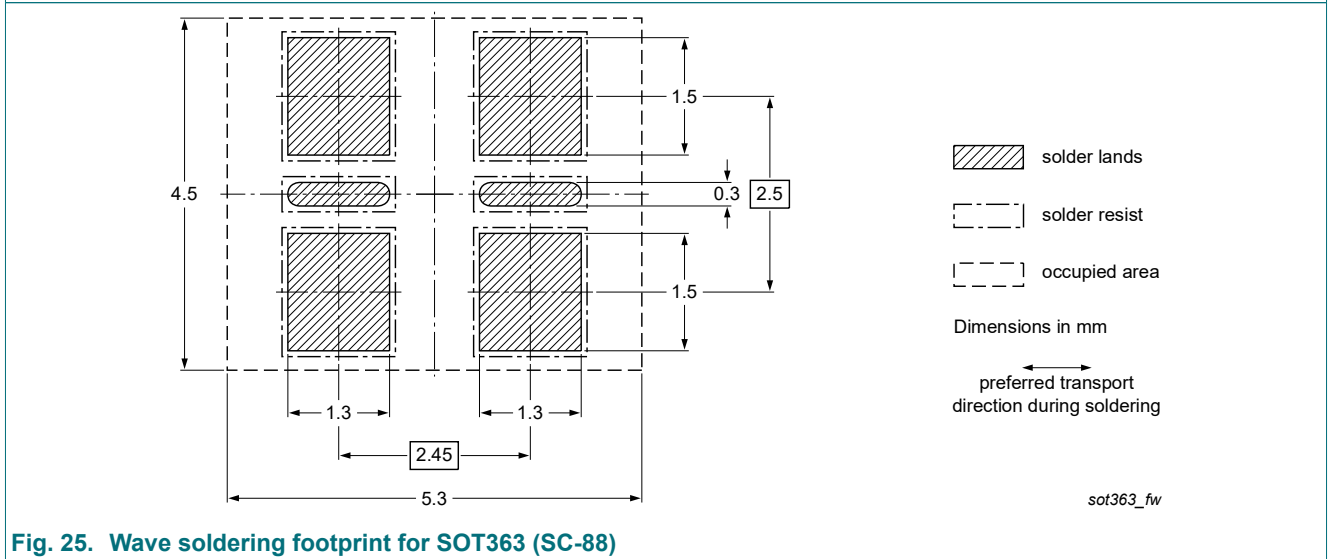


Fig. 25. Wave soldering footprint for SOT363 (SC-88)

## 14. Revision history

Table 10. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NHUMH11_1_2_SER v.1	20200722	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: 22 July 2020

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