



NHDTC114/124/144EU series

80 V, 100 mA NPN resistor-equipped transistors

Rev. 1 — 16 July 2020

Product data sheet

1. General description

NPN Resistor-Equipped Transistor (RET) family in a very small SOT323 (SC-70) Surface-Mounted Device (SMD) plastic package.

Table 1. Product overview

Type number	R1	R2	Package		PNP complement:
	k Ω	k Ω	Nexperia	JEITA	
NHDTC114EU	10	10	SOT323	SC-70	NHDTA114EU
NHDTC124EU	22	22			NHDTA124EU
NHDTC144EU	47	47			NHDTA144EU

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

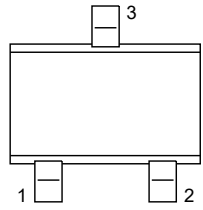
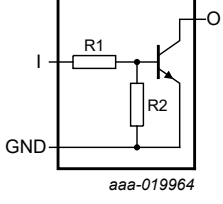
Table 2. Quick reference data

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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	I	input (base)		 aaa-019964
2	GND	GND (emitter)		
3	O	output (collector)		

6. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
NHDTC114EU	SC-70	plastic surface-mounted package; 3 leads	SOT323
NHDTC124EU			
NHDTC144EU			

7. Marking

Table 5. Marking

Type number	Marking code [1]
NHDTC114EU	5M%
NHDTC124EU	5Q%
NHDTC144EU	5S%

[1] % = placeholder for manufacturing site code

8. Limiting values

Table 6. Limiting values

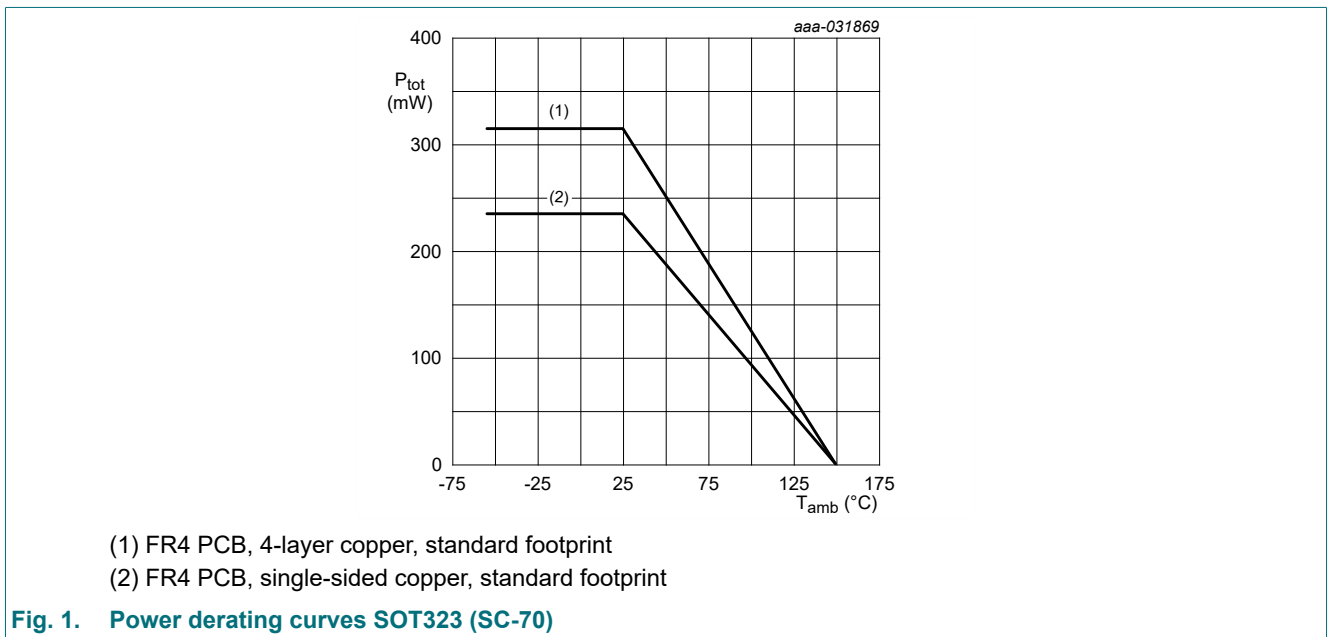
In accordance with the Absolute Maximum Rating System (IEC 60134).

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

Symbol	Parameter	Conditions	Min	Max	Unit	
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					
	NHDTC114EU		-10	+40	V	
	NHDTC124EU		-10	+60	V	
	NHDTC144EU		-10	+80	V	
I_O	output current		-	100	mA	
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	-	235	mW
			[2]	-	315	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.

[2] Device mounted on an FR4 Printed-Circuit-Board (PCB); 4-layer 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
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	532	K/W
			[2]	-	-	397	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	150	K/W

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

[2] Device mounted on an FR4 Printed-Circuit Board (PCB), 4-layer copper, tin-plated and standard footprint.

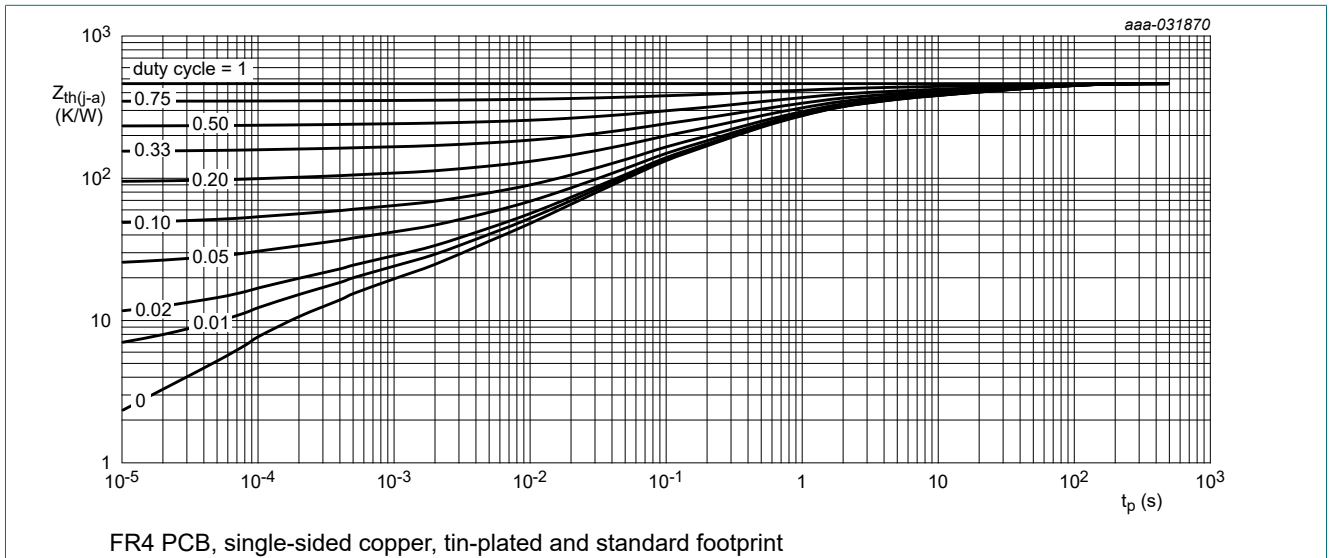


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

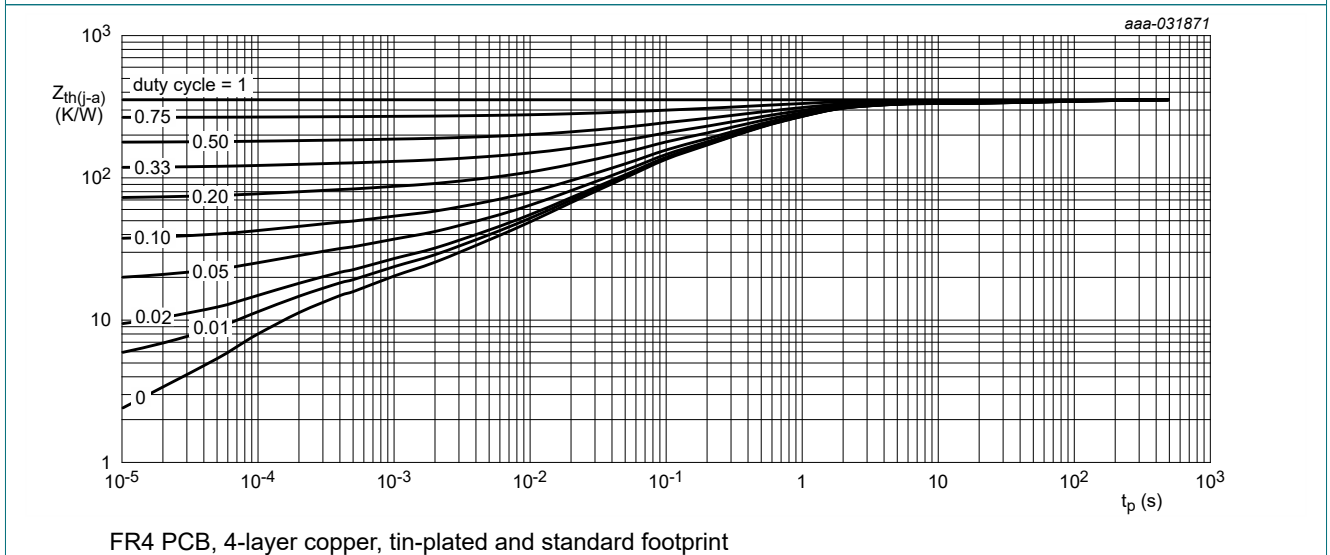


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)CBO}$	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					
	NHDTC114EU	$V_{EB} = 7\ \text{V}; I_C = 0\ \text{A}$	-	-	600	μA
	NHDTC124EU		-	-	270	μA
	NHDTC144EU		-	-	130	μA
h_{FE}	DC current gain					
	NHDTC114EU	$V_{CE} = 5\ \text{V}; I_C = 10\ \text{mA}$	50	-	-	
	NHDTC124EU		70	-	-	
	NHDTC144EU		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					
	NHDTC114EU	$V_{CE} = 0.3\ \text{V}; I_C = 10\ \text{mA}$	2.5	1.8	-	V
	NHDTC124EU		3	2.3	-	V
	NHDTC144EU		5	3.3	-	V
R1	bias resistor 1 (input)		[1]			
	NHDTC114EU		7	10	13	k Ω
	NHDTC124EU		15.4	22	28.6	k Ω
	NHDTC144EU		33	47	61	k Ω
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

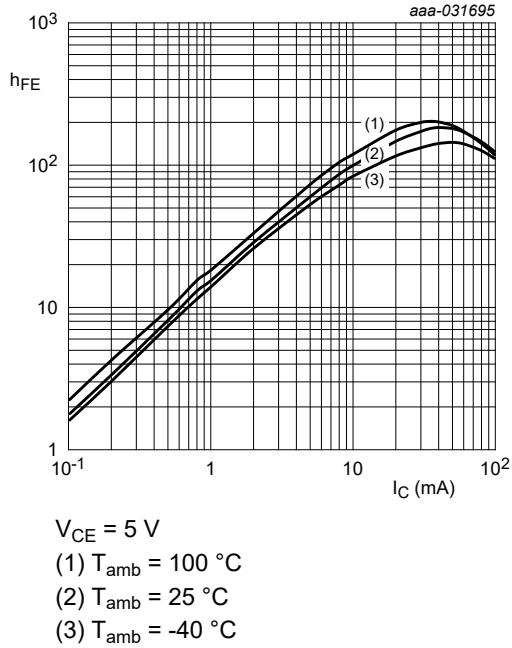


Fig. 4. NHDTC114EU: DC current gain as a function of collector current; typical values

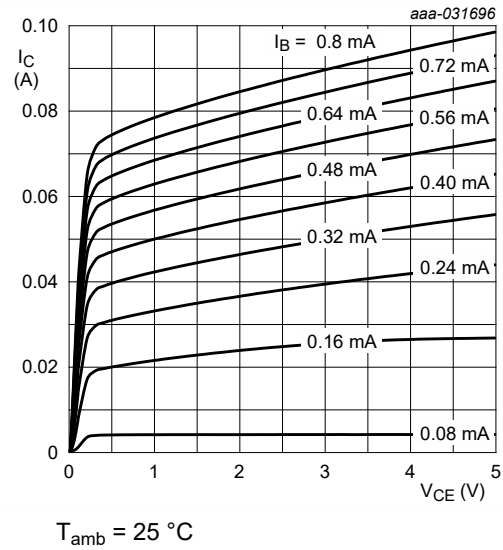


Fig. 5. NHDTC114EU: Collector current as a function of collector-emitter voltage; typical values

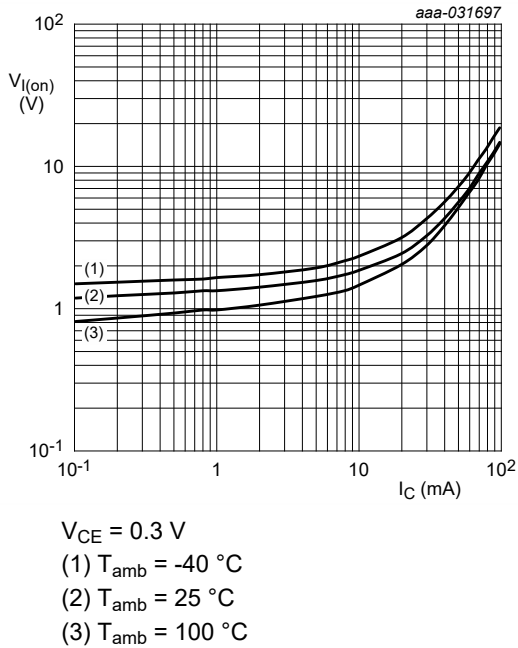


Fig. 6. NHDTC114EU: On-state input voltage as a function of collector current; typical values

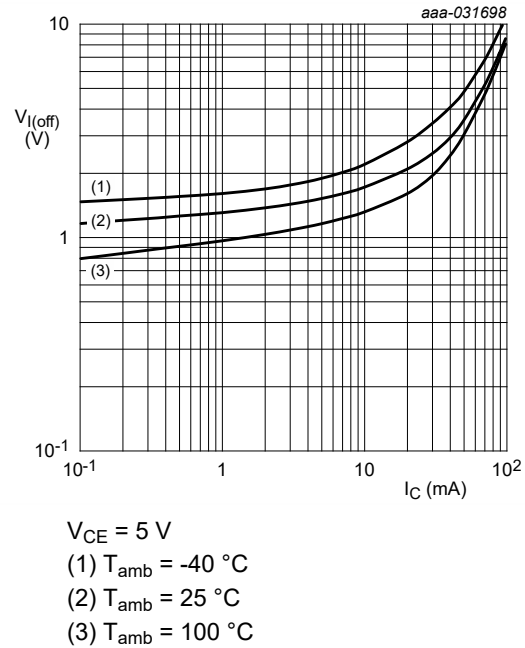
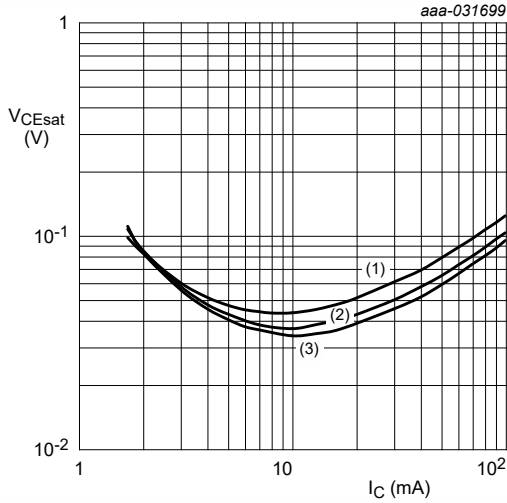
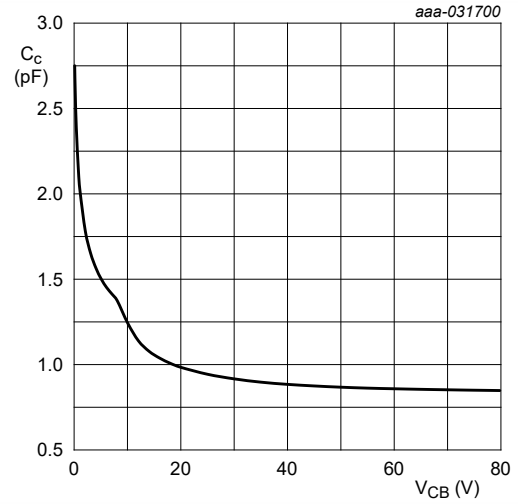


Fig. 7. NHDTC114EU: Off-state input voltage as a function of collector current; typical values



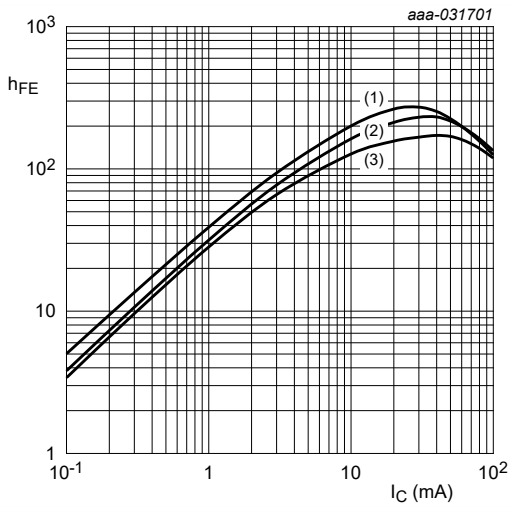
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 8. NHDTC114EU: Collector-emitter saturation voltage as a function of collector current; typical values



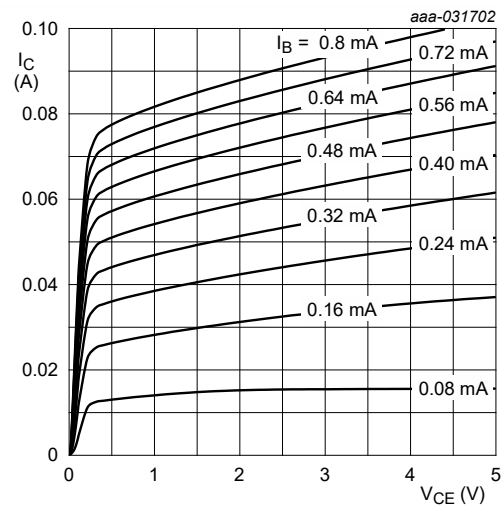
$f = 1\text{ MHz}$
 $T_{amb} = 25\text{ °C}$

Fig. 9. NHDTC114EU: Collector capacitance as a function of collector-base voltage; typical values



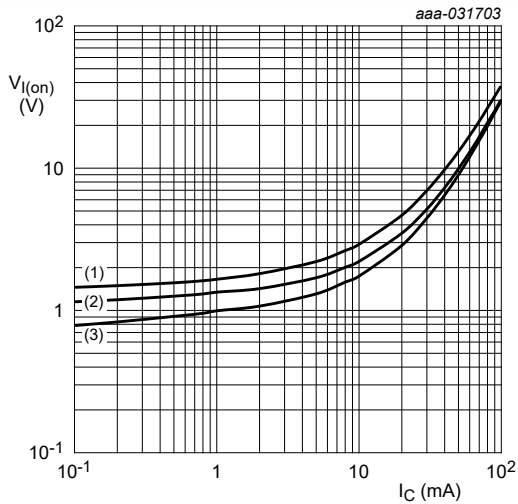
$V_{CE} = 5\text{ V}$
 (1) $T_{amb} = 100\text{ °C}$
 (2) $T_{amb} = 25\text{ °C}$
 (3) $T_{amb} = -40\text{ °C}$

Fig. 10. NHDTC124EU: DC current gain as a function of collector current; typical values



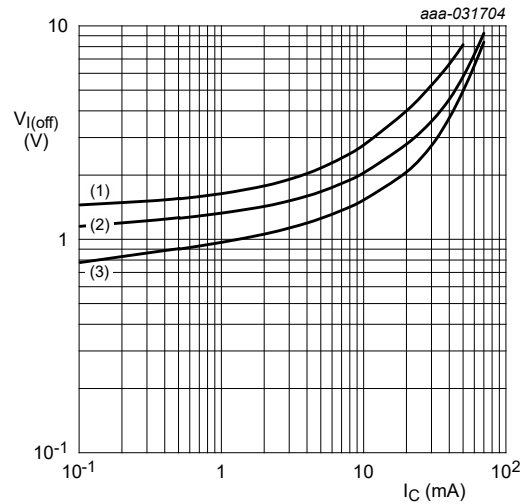
$T_{amb} = 25\text{ °C}$

Fig. 11. NHDTC124EU: Collector current as a function of collector-emitter voltage; typical values



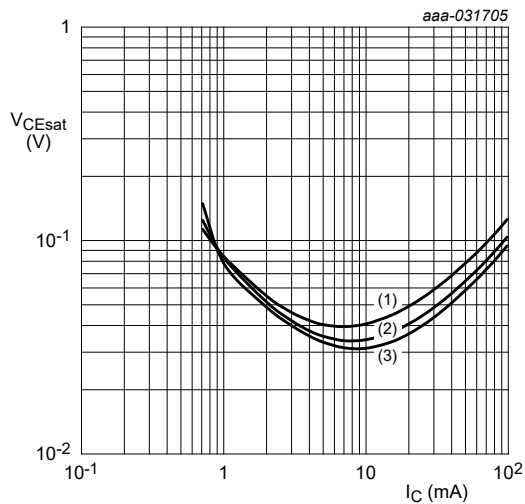
$V_{CE} = 0.3 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 12. NHDTC124EU: On-state input voltage as a function of collector current; typical values



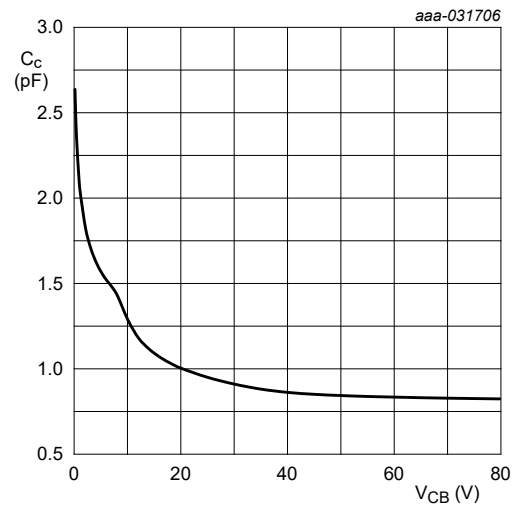
$V_{CE} = 5 \text{ V}$
 (1) $T_{amb} = -40 \text{ }^\circ\text{C}$
 (2) $T_{amb} = 25 \text{ }^\circ\text{C}$
 (3) $T_{amb} = 100 \text{ }^\circ\text{C}$

Fig. 13. NHDTC124EU: 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. 14. NHDTC124EU: Collector-emitter saturation voltage as a function of collector current; typical values



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

Fig. 15. NHDTC124EU: Collector capacitance as a function of collector-base voltage; typical values

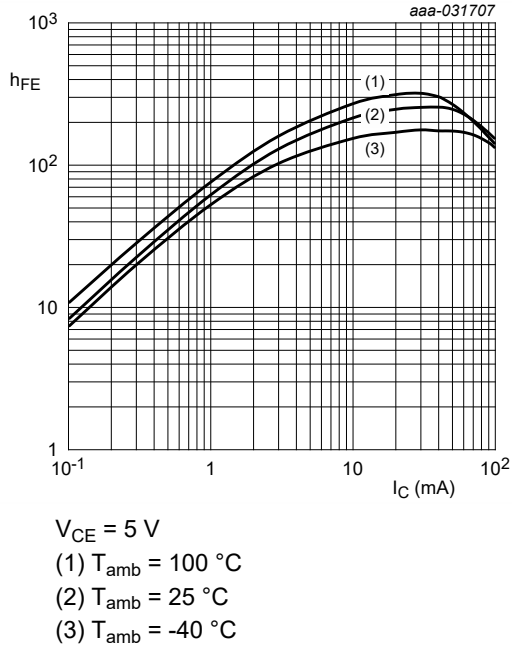


Fig. 16. NHDTC144EU: DC current gain as a function of collector current; typical values

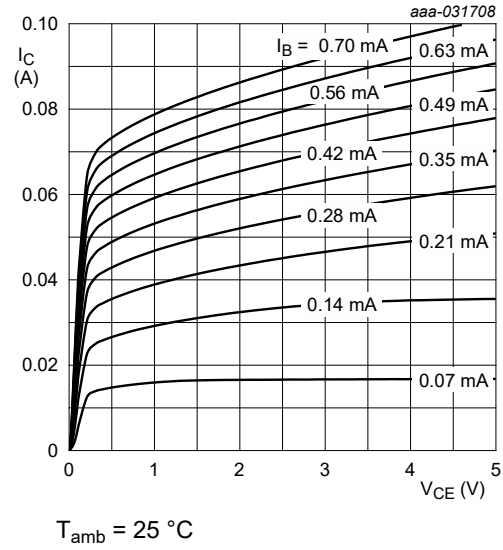


Fig. 17. NHDTC144EU: Collector current as a function of collector-emitter voltage; typical values

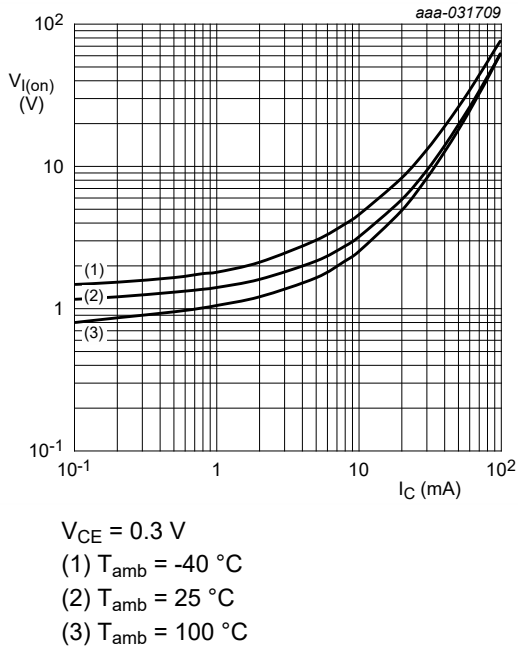


Fig. 18. NHDTC144EU: On-state input voltage as a function of collector current; typical values

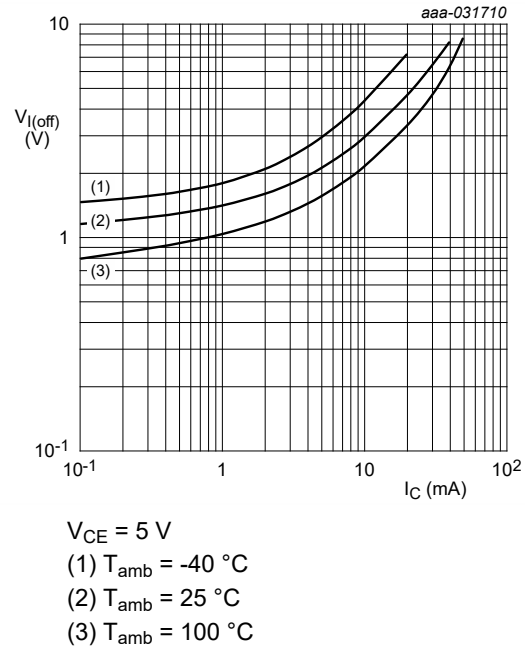
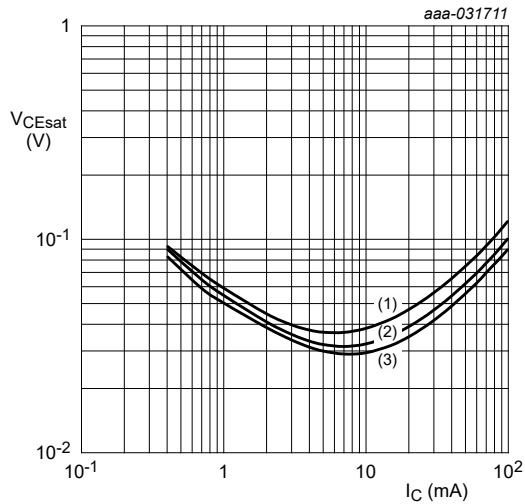
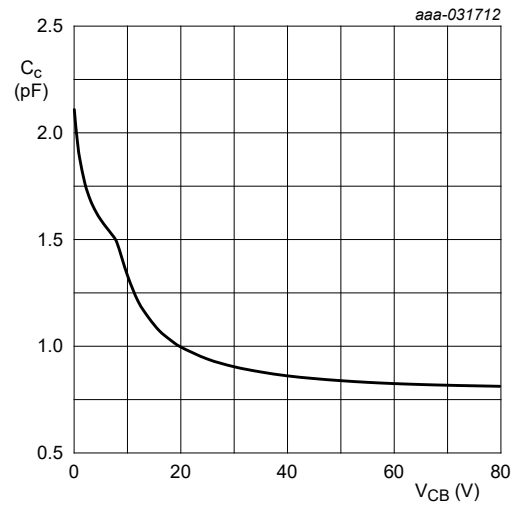


Fig. 19. NHDTC144EU: Off-state input voltage as a function of collector current; typical values



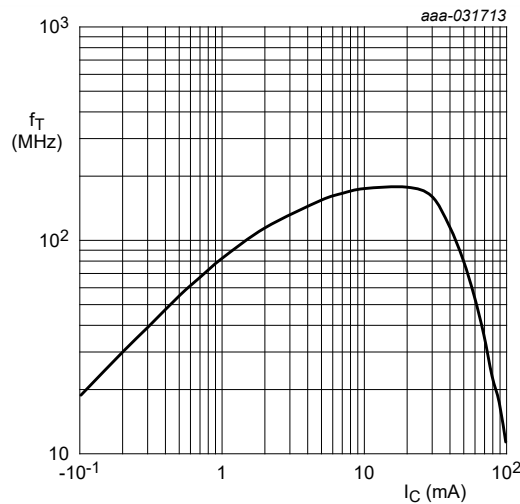
$I_C/I_B = 20$
 (1) $T_{amb} = 100\text{ }^\circ\text{C}$
 (2) $T_{amb} = 25\text{ }^\circ\text{C}$
 (3) $T_{amb} = -40\text{ }^\circ\text{C}$

Fig. 20. NHDTC144EU: Collector-emitter saturation voltage as a function of collector current; typical values



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

Fig. 21. NHDTC144EU: Collector capacitance as a function of collector-base voltage; typical values



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

Fig. 22. 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)

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

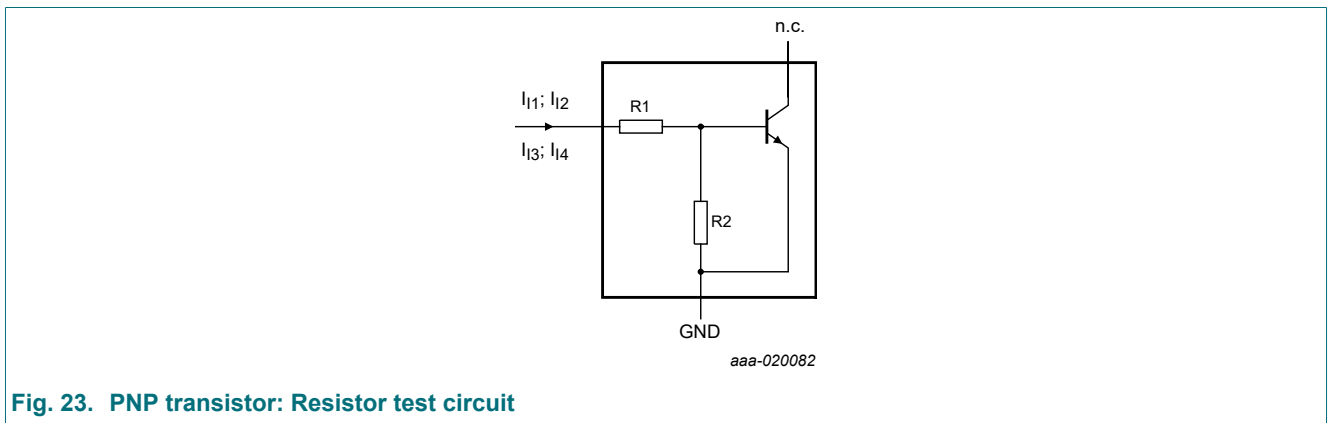


Fig. 23. PNP transistor: Resistor test circuit

Resistor test conditions

Table 9. Resistor test conditions

Type number	R1 (kΩ)	R2 (kΩ)	Test conditions			
			I ₁₁	I ₁₂	I ₁₃	I ₁₄
NHDTC114EU	10	10	800 μA	1.1 mA	-350 μA	-450 μA
NHDTC124EU	22	22	550 μA	750 μA	-150 μA	-230 μA
NHDTC144EU	47	47	250 μA	350 μA	-55 μA	-105 μA

12. Package outline

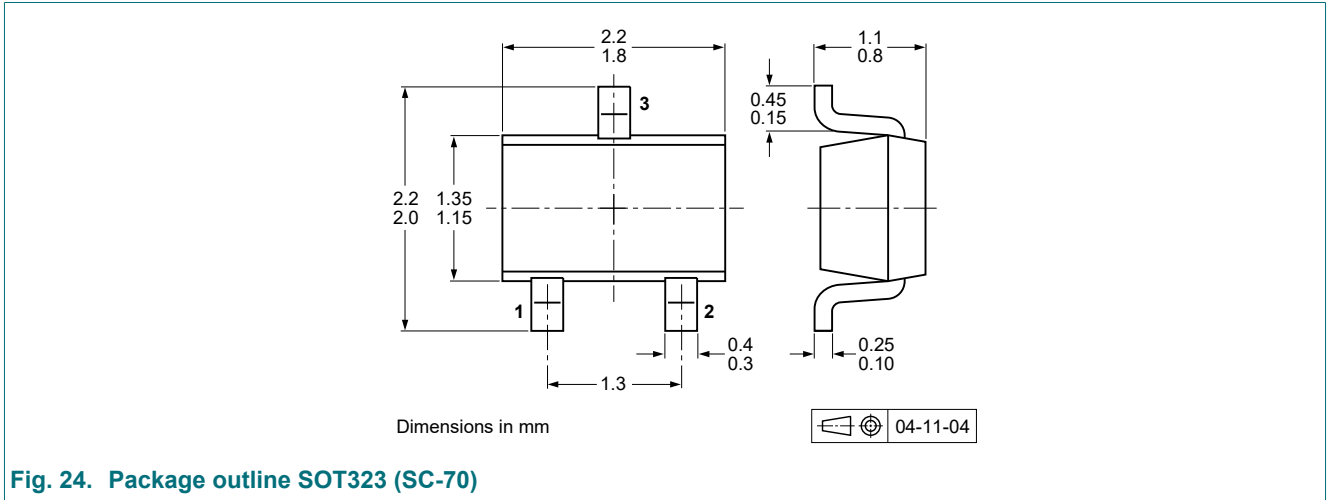


Fig. 24. Package outline SOT323 (SC-70)

13. Soldering

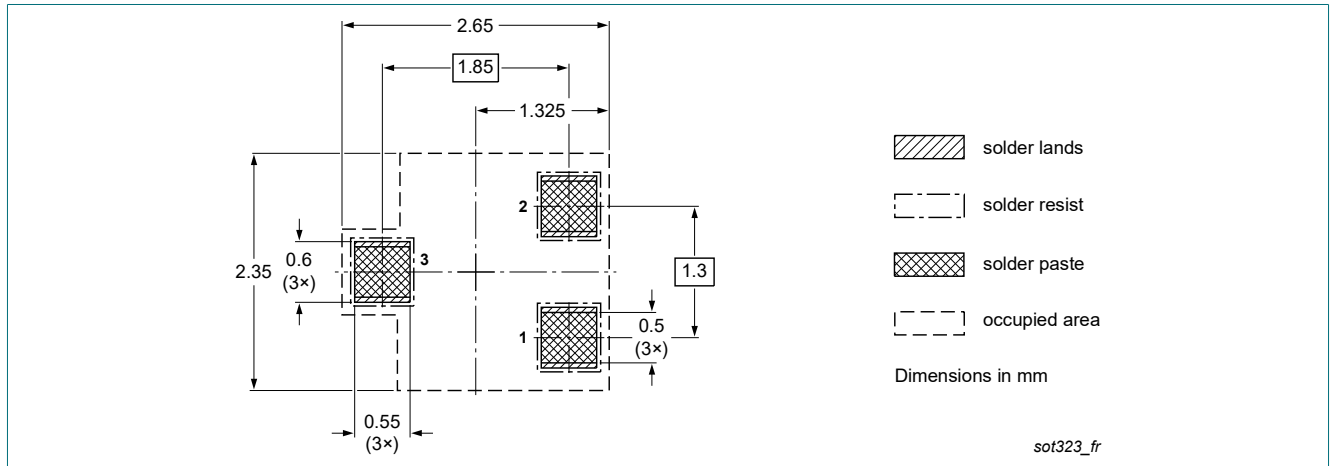


Fig. 25. Reflow soldering footprint for SOT323 (SC-70)

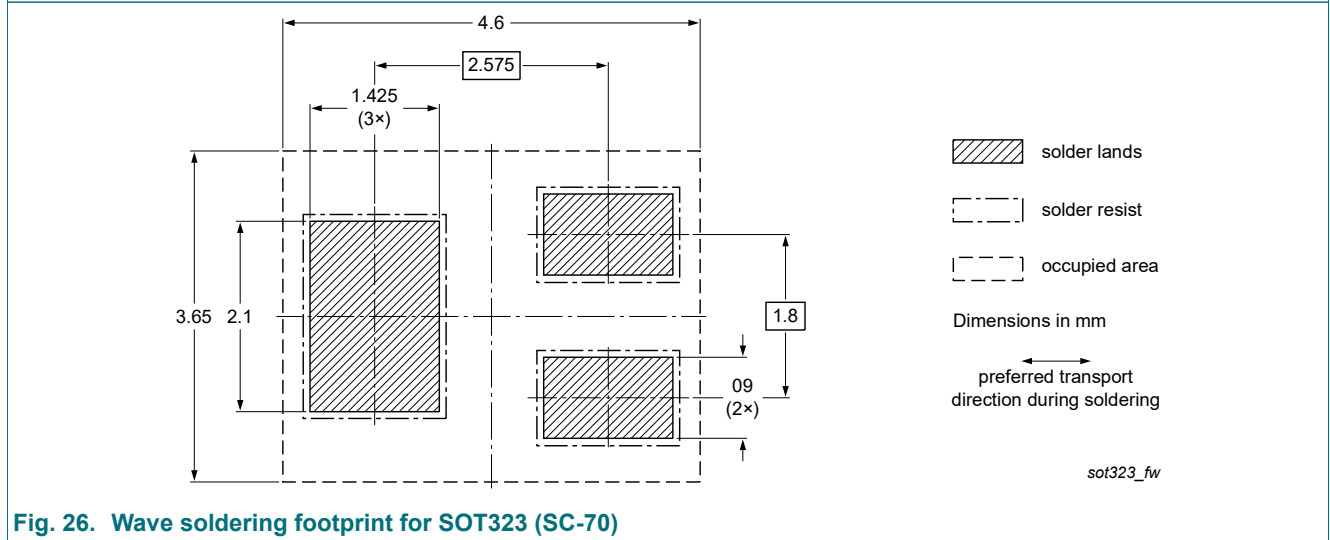


Fig. 26. Wave soldering footprint for SOT323 (SC-70)

14. Revision history

Table 10. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NHDTC114_124_144EU_SER v.1	20200716	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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- [2] The term 'short data sheet' is explained in section "Definitions".
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Contents

1. General description.....	1
2. Features and benefits.....	1
3. Applications.....	1
4. Quick reference data.....	1
5. Pinning information.....	2
6. Ordering information.....	2
7. Marking.....	2
8. Limiting values.....	3
9. Thermal characteristics.....	4
10. Characteristics.....	5
11. Test information.....	11
12. Package outline.....	12
13. Soldering.....	13
14. Revision history.....	14
15. Legal information.....	15

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