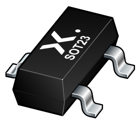


NHDTC114/124/144ET series

80 V, 100 mA NPN resistor-equipped transistors

Rev. 1 — 26 June 2020 Product data sheet

1. General description

NPN Resistor-Equipped Transistor (RET) family in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package.

Table 1. Product overview

Type number	R1	R2	Package		PNP complement:
	kΩ	kΩ	Nexperia	JEDEC	
NHDTC114ET	10	10	SOT23	TO-236AB	NHDTA114ET
NHDTC124ET	22	22			NHDTA124ET
NHDTC144ET	47	47			NHDTA144ET

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

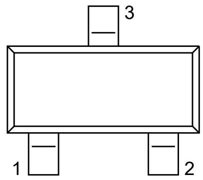
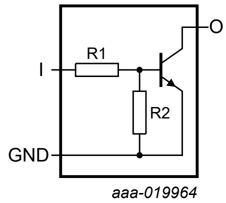
T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CEO}	collector-emitter voltage	open base	-	-	80	V
I_O	output current		-	-	100	mA

nexperia

5. Pinning information

Table 3. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	I	input (base)		
2	GND	GND (emitter)		
3	O	output (collector)		

6. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
NHDTC114ET	TO-236AB	plastic surface-mounted package; 3 leads	SOT23
NHDTC124ET			
NHDTC144ET			

7. Marking

Table 5. Marking

Type number	Marking code [1]
NHDTC114ET	QG%
NHDTC124ET	QK%
NHDTC144ET	QM%

[1] % = placeholder for manufacturing site code

8. Limiting values

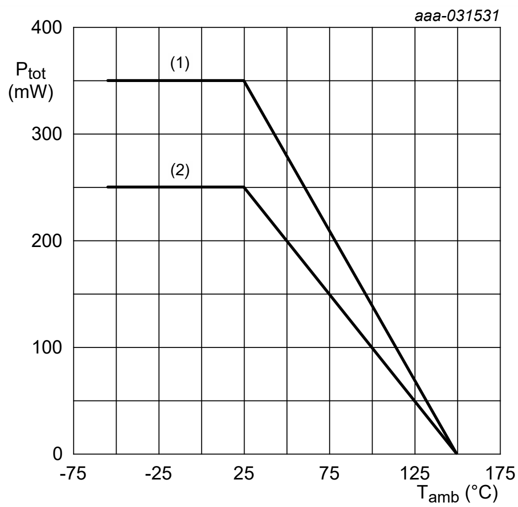
Table 6. Limiting values

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

T_{amb} = 25 °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					
	NHDTC114ET			-10	+40	V
	NHDTC124ET			-10	+60	V
	NHDTC144ET			-10	+80	V
I_O	output current			-	100	mA
P_{tot}	total power dissipation	T_{amb} ≤ 25 °C	[1]	-	250	mW
			[2]	-	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.
[2] Device mounted on an FR4 Printed-Circuit-Board (PCB);4-layer copper; tin-plated and standard footprint.



(1) FR4 PCB, 4-layer copper, standard footprint
(2) FR4 PCB, single-sided copper, standard footprint

Fig. 1. Power derating curves for SOT23 (TO-236AB)

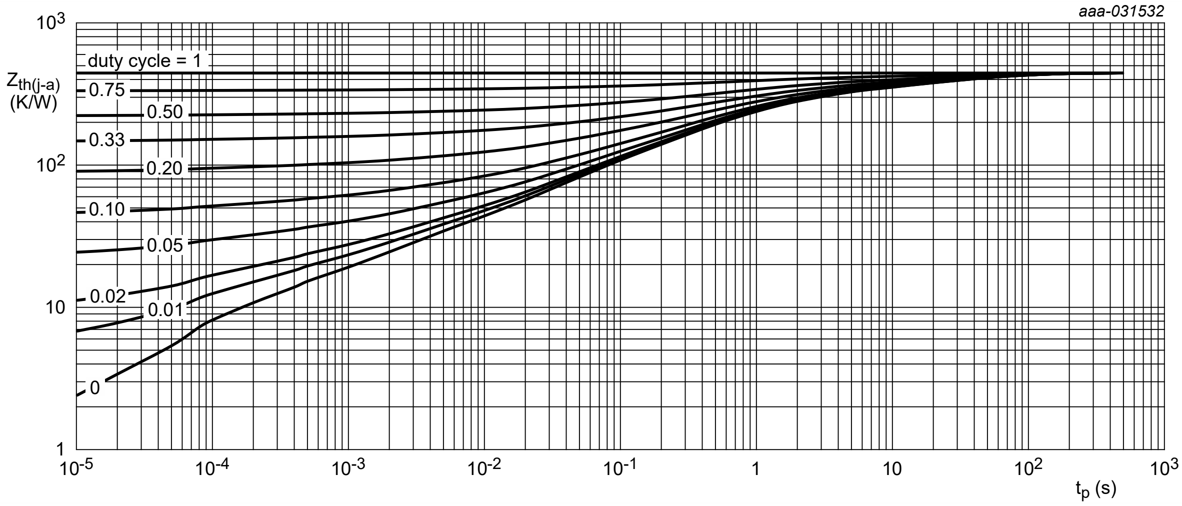
9. Thermal characteristics

Table 7. Thermal characteristics

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

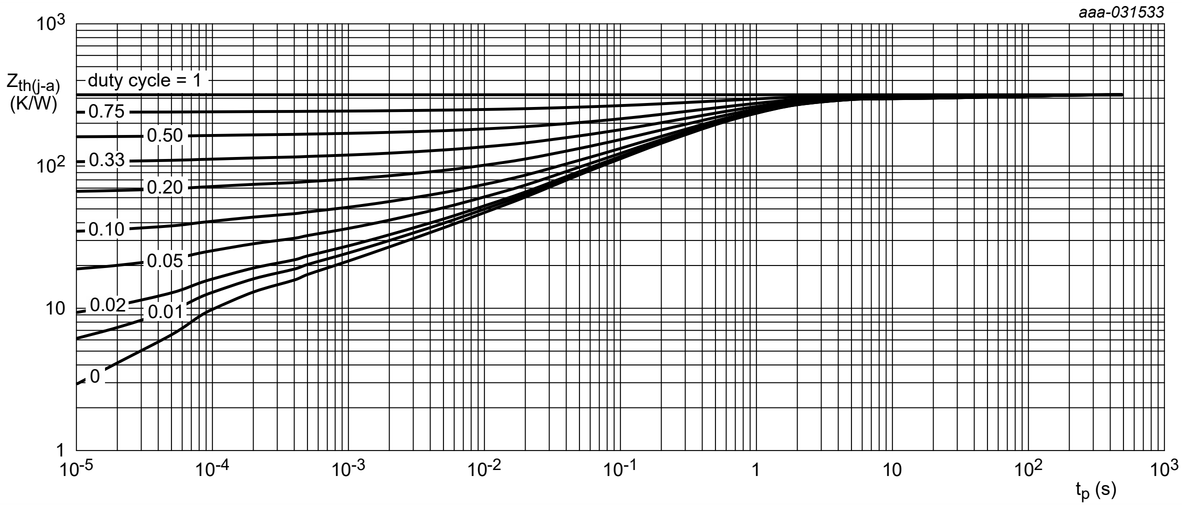
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	500	K/W
			[2]	-	-	358	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	130	K/W

[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.



FR4 PCB, single-sided copper, tin-plated and standard footprint

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



FR4 PCB, 4-layer copper, tin-plated and standard footprint

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

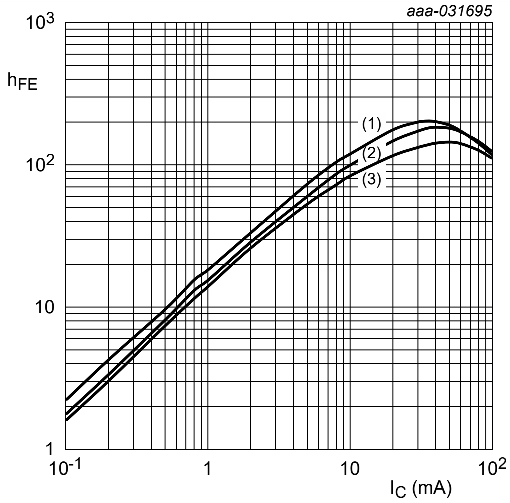
10. Characteristics

Table 8. Characteristics

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

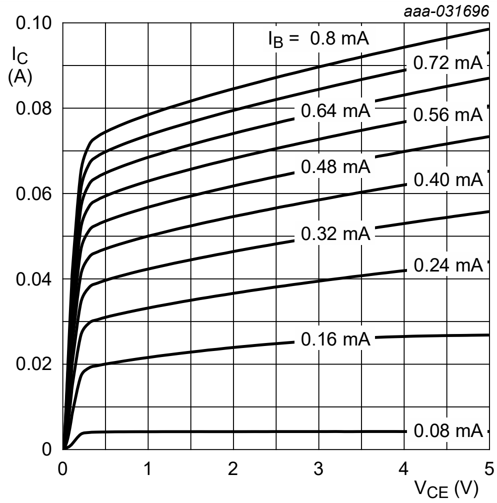
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 100 µA; I_E = 0 A		80	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 2 mA; I_B = 0 A		80	-	-	V
I_{CBO}	collector-base cut-off current	V_{CB} = 80 V; I_E = 0 A		-	-	100	nA
I_{CEO}	collector-emitter 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						
	NHDTC114ET	V_{EB} = 7 V; I_C = 0 A		-	-	600	µA
	NHDTC124ET			-	-	270	µA
	NHDTC144ET			-	-	130	µA
h_{FE}	DC current gain						
	NHDTC114ET	V_{CE} = 5 V; I_C = 10 mA		50	-	-	
	NHDTC124ET			70	-	-	
	NHDTC144ET			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	V_{CE} = 5 V ; I_C = 100 µA		-	1.15	0.8	V
$V_{I(on)}$	on-state input voltage						
	NHDTC114ET	V_{CE} = 0.3 V ; I_C = 10 mA		2.5	1.8	-	V
	NHDTC124ET			3	2.3	-	V
	NHDTC144ET			5	3.3	-	V
R1	bias resistor 1 (input)		[1]				
	NHDTC114ET			7	10	13	kΩ
	NHDTC124ET			15.4	22	28.6	kΩ
	NHDTC144ET			33	47	61	kΩ
R2/R1	bias resitor ratio		[1]	0.8	1	1.2	
f_T	transition frequency	V_{CE} = 5 V; I_C = 10 mA; f = 100 MHz	[2]	-	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



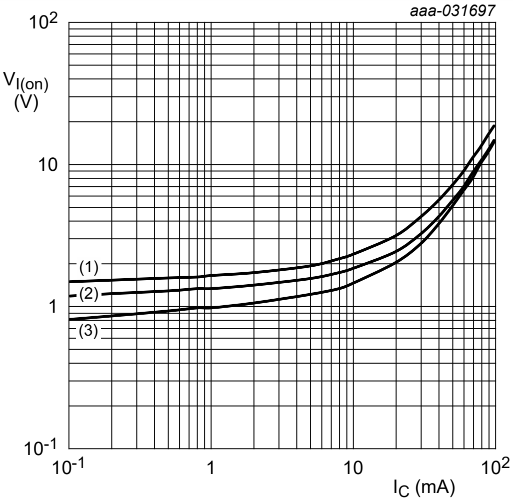
V_{CE} = 5 V
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = -40 °C

Fig. 4. NHDTC114ET: DC current gain as a function of collector current; typical values



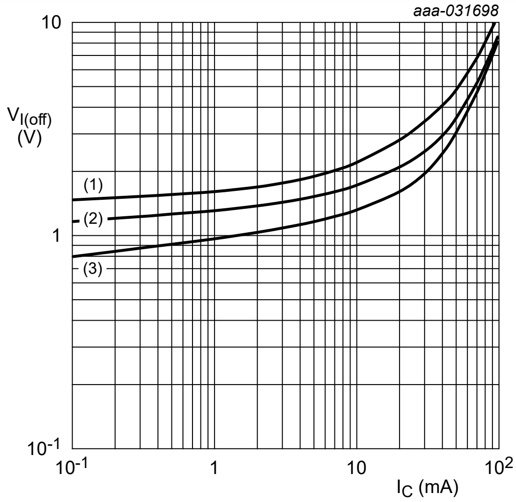
T_{amb} = 25 °C

Fig. 5. NHDTC114ET: Collector current as a function of collector-emitter voltage; typical values



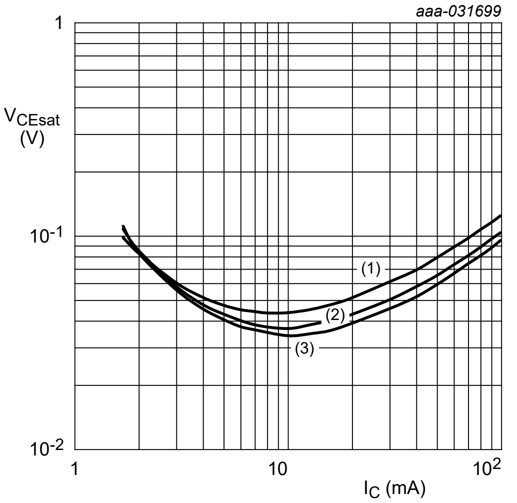
V_{CE} = 0.3 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

Fig. 6. NHDTC114ET: 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. 7. NHDTC114ET: Off-state input voltage as a function of collector current; typical values



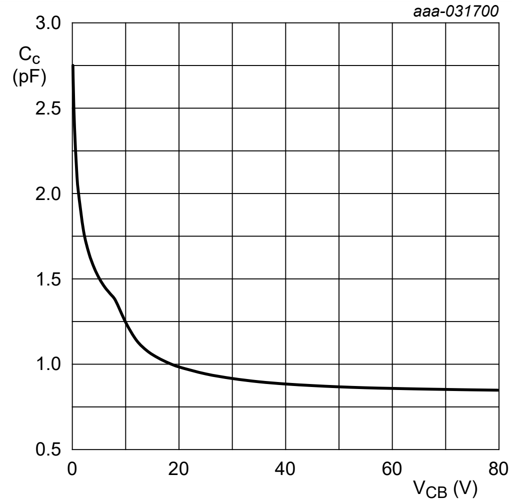
$I_C/I_B = 20$

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = -40 °C

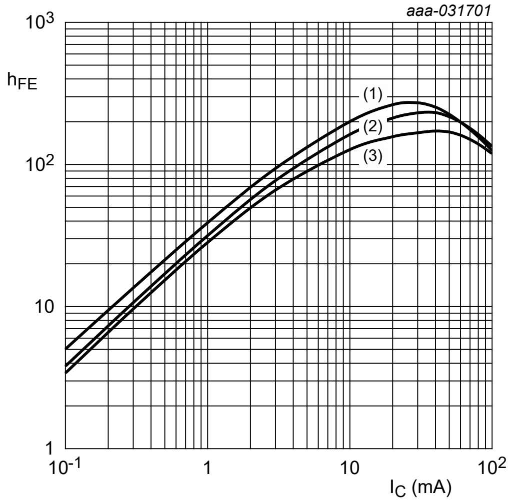
Fig. 8. NHDTC114ET: Collector-emitter saturation voltage as a function of collector current; typical values



f = 1 MHz

T_{amb} = 25 °C

Fig. 9. NHDTC114ET: Collector capacitance as a function of collector-base voltage; typical values



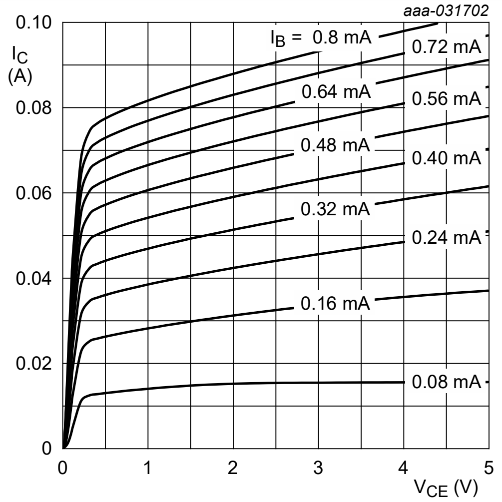
V_{CE} = 5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

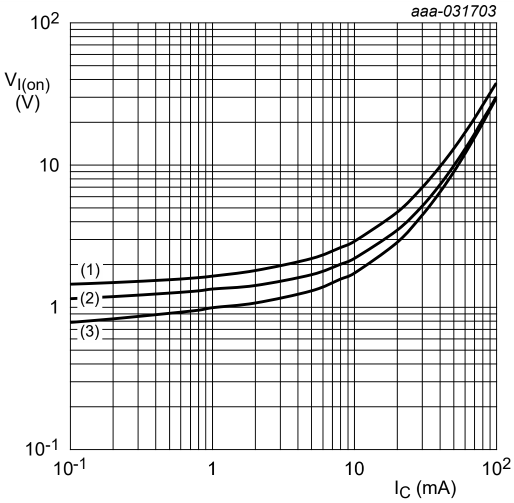
(3) T_{amb} = -40 °C

Fig. 10. NHDTC124ET: DC current gain as a function of collector current; typical values



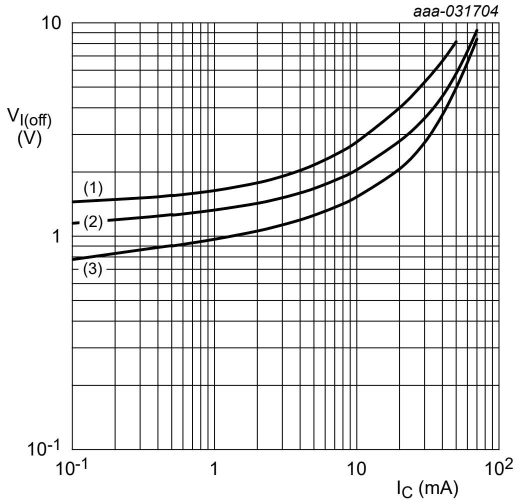
T_{amb} = 25 °C

Fig. 11. NHDTC124ET: Collector current as a function of collector-emitter voltage; typical values



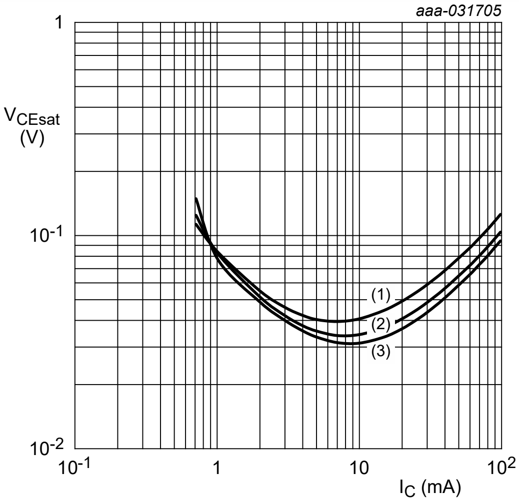
V_{CE} = 0.3 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

Fig. 12. NHDTC124ET: On-state input voltage as a function of collector current; typical values



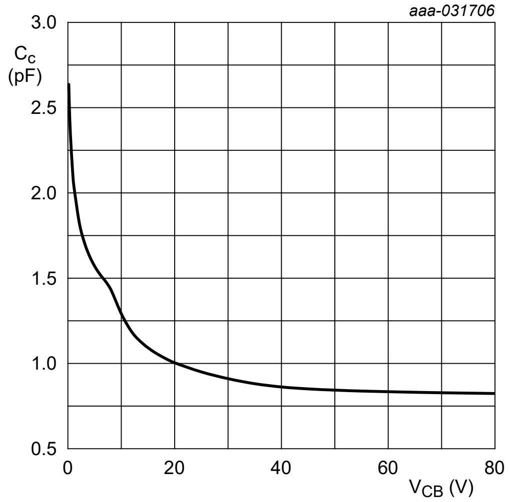
V_{CE} = 5 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

Fig. 13. NHDTC124ET: Off-state input voltage as a function of collector current; typical values



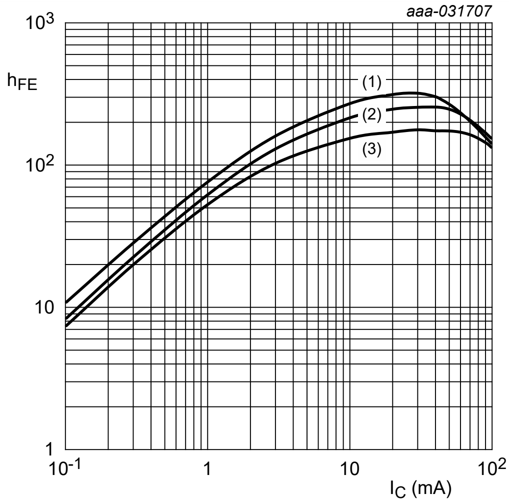
I_C/I_B = 20
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = -40 °C

Fig. 14. NHDTC124ET: Collector-emitter saturation voltage as a function of collector current; typical values



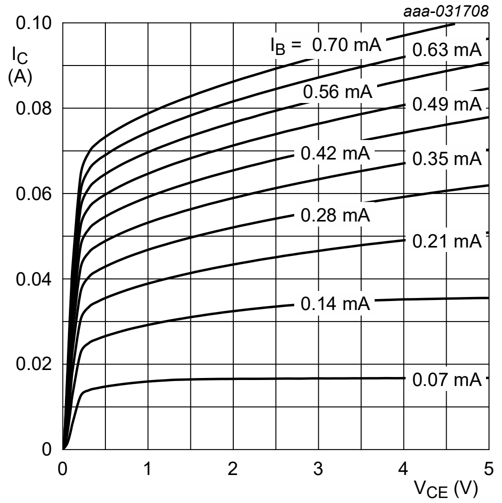
f = 1 MHz
T_{amb} = 25 °C

Fig. 15. NHDTC124ET: Collector capacitance as a function of collector-base voltage; typical values



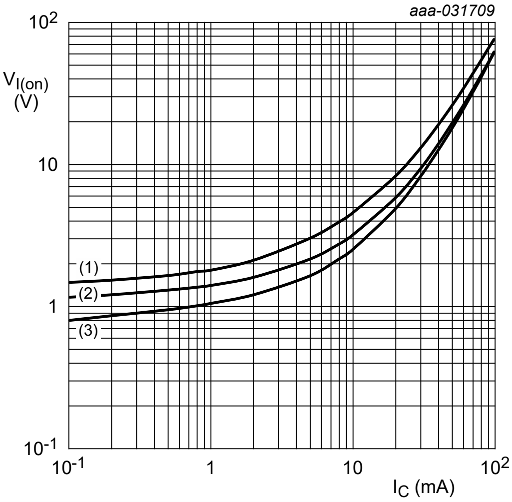
V_{CE} = 5 V
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = -40 °C

Fig. 16. NHDTC144ET: DC current gain as a function of collector current; typical values



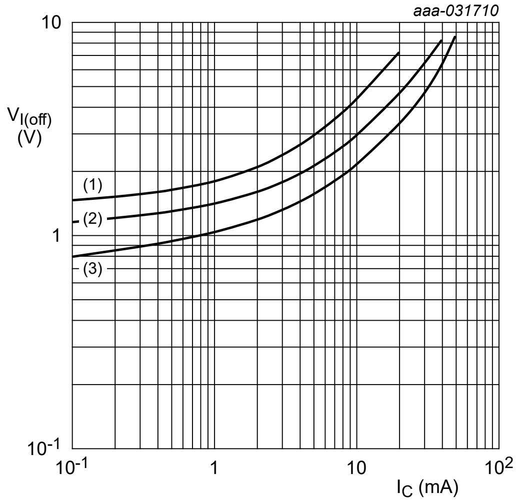
T_{amb} = 25 °C

Fig. 17. NHDTC144ET: Collector current as a function of collector-emitter voltage; typical values



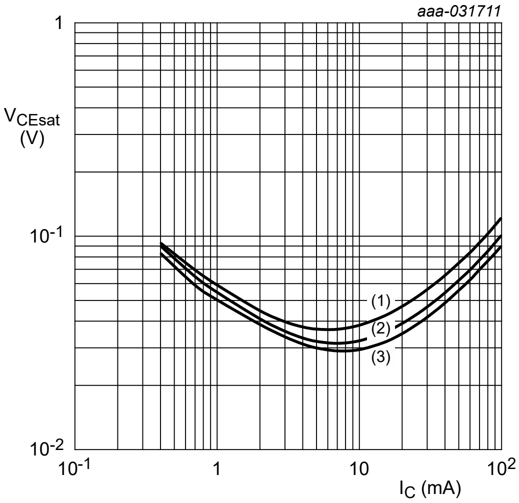
V_{CE} = 0.3 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

Fig. 18. NHDTC144ET: On-state input voltage as a function of collector current; typical values



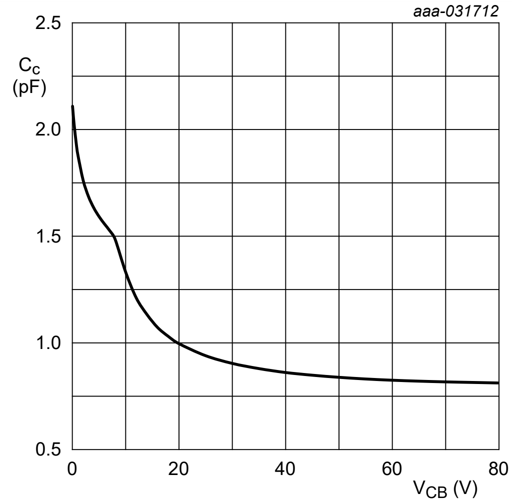
V_{CE} = 5 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = 100 °C

Fig. 19. NHDTC144ET: Off-state input voltage as a function of collector current; typical values



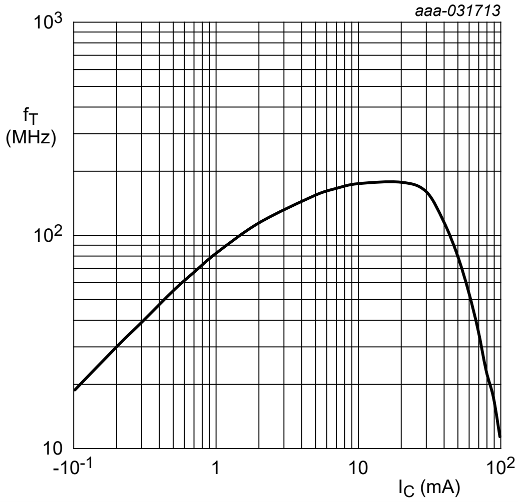
I_C/I_B = 20
(1) T_{amb} = 100 °C
(2) T_{amb} = 25 °C
(3) T_{amb} = -40 °C

Fig. 20. NHDTC144ET: Collector-emitter saturation voltage as a function of collector current; typical values



f = 1 MHz
T_{amb} = 25 °C

Fig. 21. NHDTC144ET: Collector capacitance as a function of collector-base voltage; typical values



f = 100 MHz
V_{CE} = 5 V
T_{amb} = 25 °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)

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

- Calculation of bias resistor ratio (R2/R1)

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

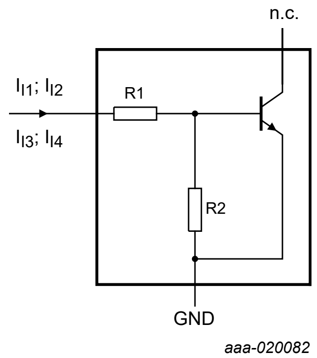


Fig. 23. PNP transistor: Resistor test circuit

Resistor test conditions

Table 9. Resistor test conditions

Type number	R1 (kΩ)	R2 (kΩ)	Test conditions			
			I_{I1}	I_{I2}	I_{I3}	I_{I4}
NHDTC114ET	10	10	800 µA	1.1 mA	-350 µA	-450 µA
NHDTC124ET	22	22	550 µA	750 µA	-150 µA	-230 µA
NHDTC144ET	47	47	250 µA	350 µA	-55 µA	-105 µA

12. Package outline

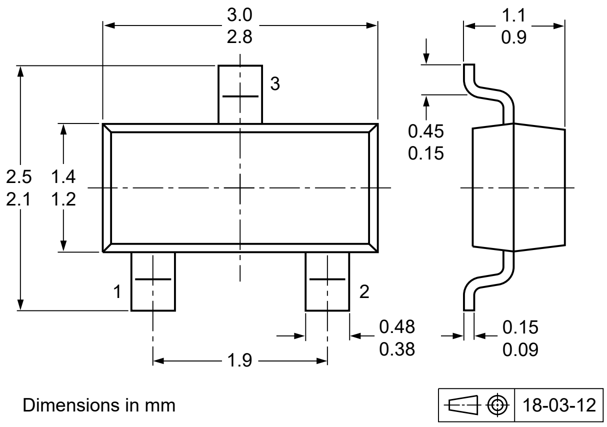


Fig. 24. Package outline TO-236AB (SOT23)

13. Soldering

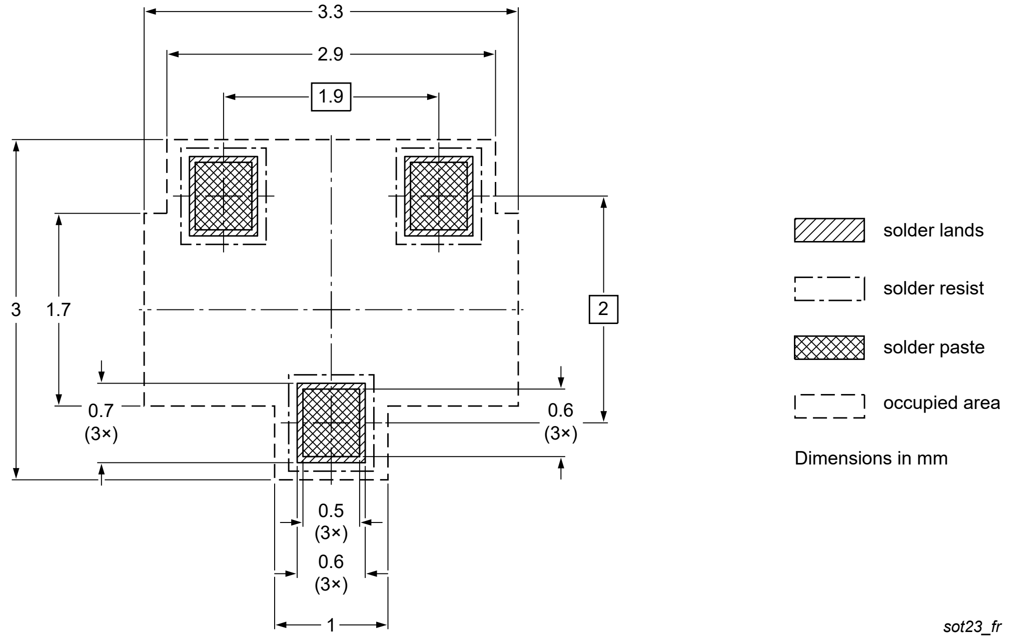


Fig. 25. Reflow soldering footprint for TO-236AB (SOT23)

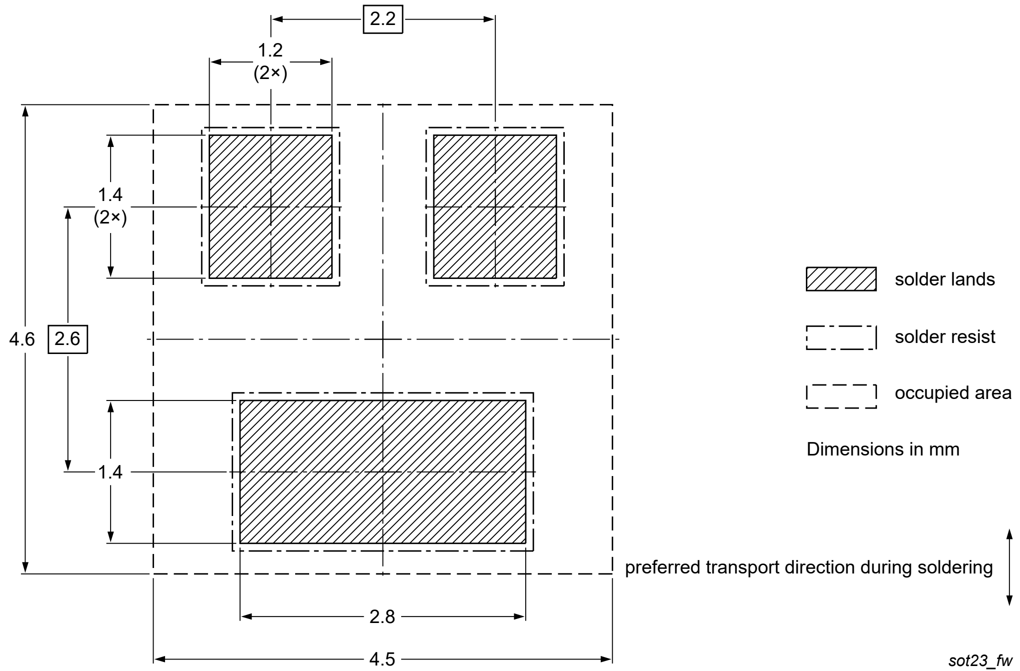


Fig. 26. Wave soldering footprint for TO-236AB (SOT23)

14. Revision history

Table 10. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NHDTC114_124_144ET_SER v.1	20200626	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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