



NHDTC114/124/144ET-Q series

80 V, 100 mA NPN resistor-equipped transistors

Rev. 1 — 17 October 2024

Product data sheet

1. General description

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

Table 1. Product overview

Type number	R1	R2	Package	PNP complement:
	k Ω	k Ω	Nexperia	
NHDTC114ET-Q	10	10	SOT23	NHDTA114ET-Q
NHDTC124ET-Q	22	22		NHDTA124ET-Q
NHDTC144ET-Q	47	47		NHDTA144ET-Q

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
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

- Digital applications
- Cost saving alternative for BC846 series in digital applications
- Controlling IC inputs
- Switching loads

4. Quick reference data

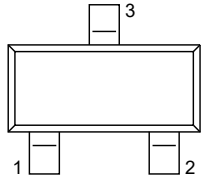
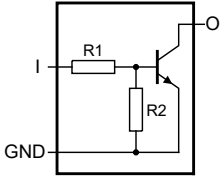
Table 2. Quick reference data

$T_{amb} = 25\text{ }^{\circ}\text{C}$ 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
NHDTTC114ET-Q	SOT23	plastic surface-mounted package; 3 leads	SOT23
NHDTTC124ET-Q			
NHDTTC144ET-Q			

7. Marking

Table 5. Marking

Type number	Marking code [1]
NHDTTC114ET-Q	QG%
NHDTTC124ET-Q	QK%
NHDTTC144ET-Q	QM%

[1] % = placeholder for manufacturing site code

8. Limiting values

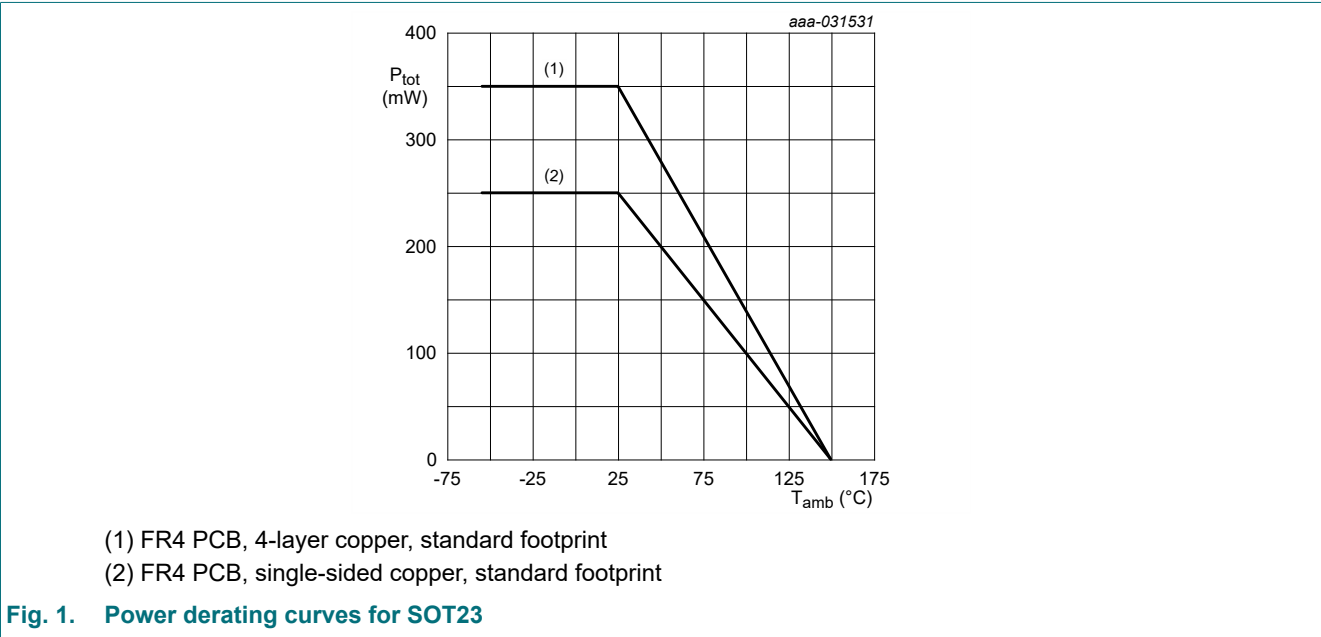
Table 6. Limiting values

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-Q		-10	+40	V
	NHDTC124ET-Q		-10	+60	V
	NHDTC144ET-Q		-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.



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.

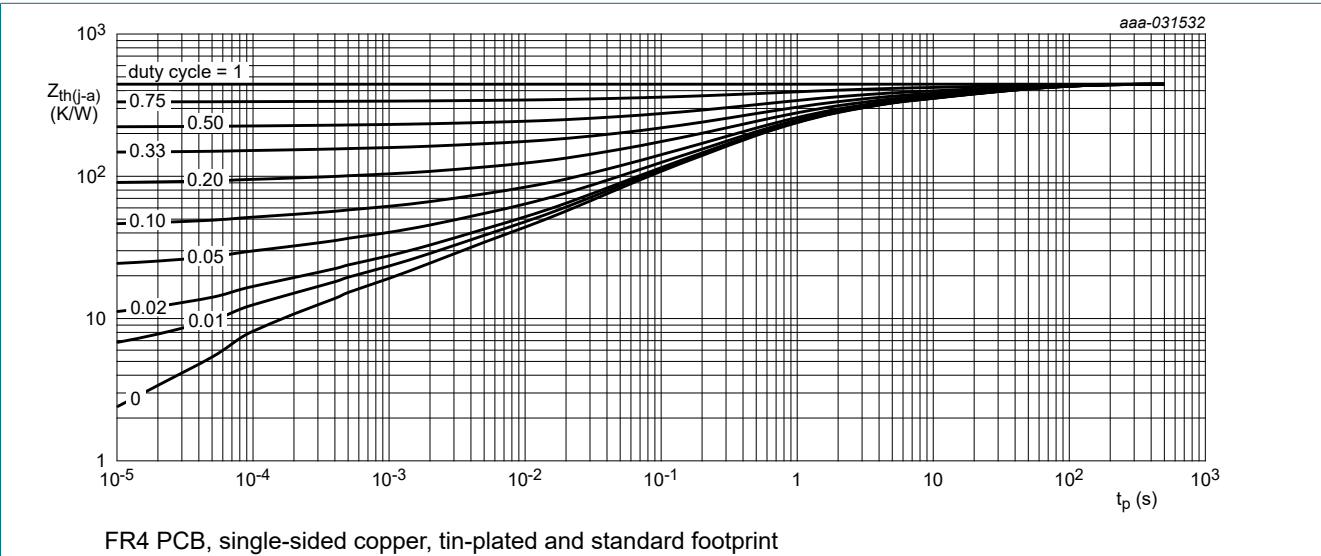


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

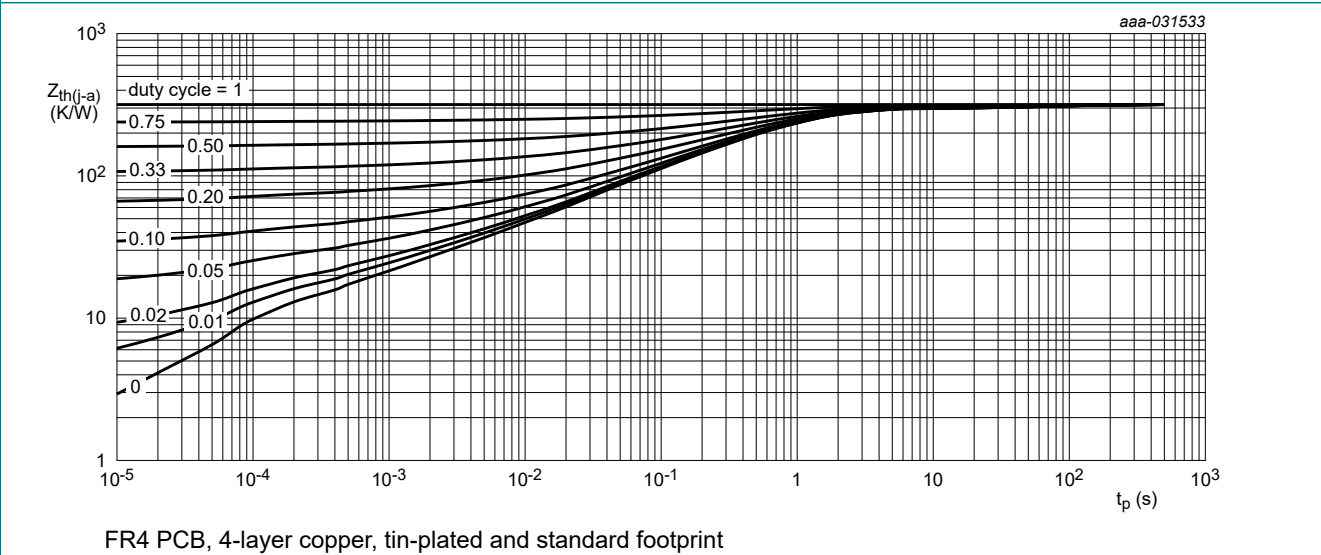


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 8. Characteristics

T_{amb} = 25 °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-Q	V _{EB} = 7 V; I _C = 0 A	-	-	600	μA
	NHDTC124ET-Q		-	-	270	μA
	NHDTC144ET-Q		-	-	130	μA
h _{FE}	DC current gain					
	NHDTC114ET-Q	V _{CE} = 5 V; I _C = 10 mA	50	-	-	
	NHDTC124ET-Q		70	-	-	
	NHDTC144ET-Q		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-Q	V _{CE} = 0.3 V ; I _C = 10 mA	2.5	1.8	-	V
	NHDTC124ET-Q		3	2.3	-	V
	NHDTC144ET-Q		5	3.3	-	V
R1	bias resistor 1 (input)		[1]			
	NHDTC114ET-Q		7	10	13	kΩ
	NHDTC124ET-Q		15.4	22	28.6	kΩ
	NHDTC144ET-Q		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

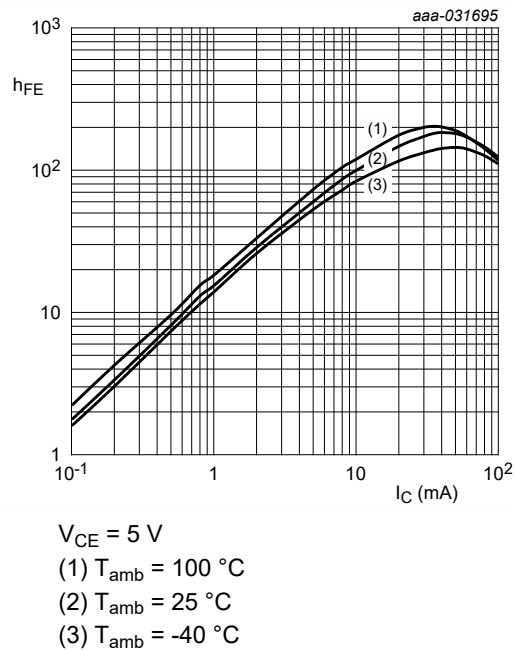


Fig. 4. NHDTC114ET-Q: DC current gain as a function of collector current; typical values

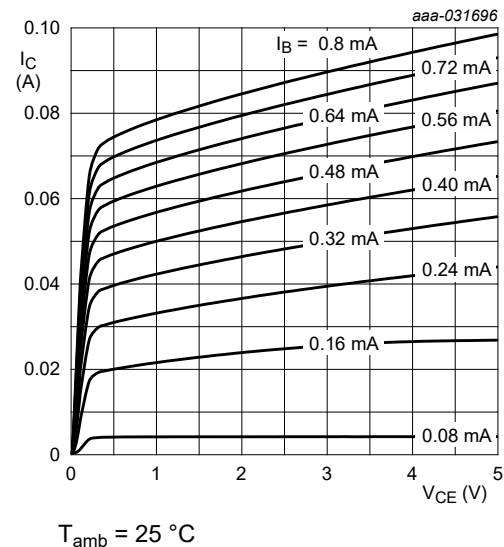


Fig. 5. NHDTC114ET-Q: Collector current as a function of collector-emitter voltage; typical values

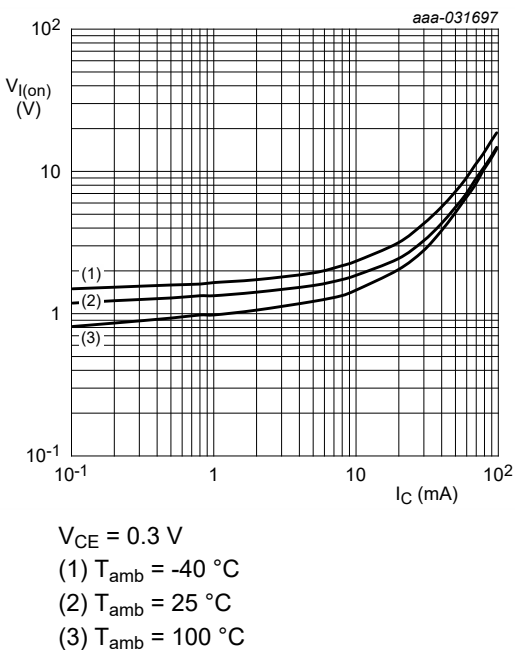


Fig. 6. NHDTC114ET-Q: On-state input voltage as a function of collector current; typical values

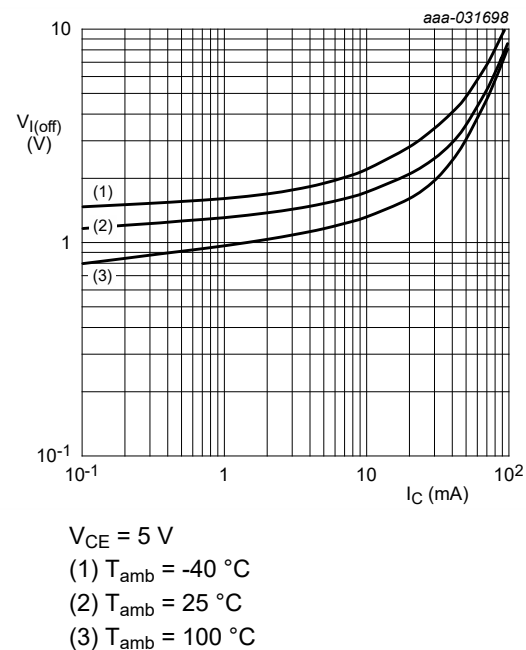
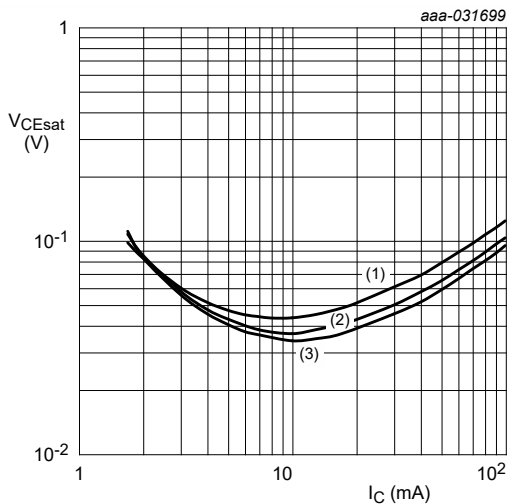
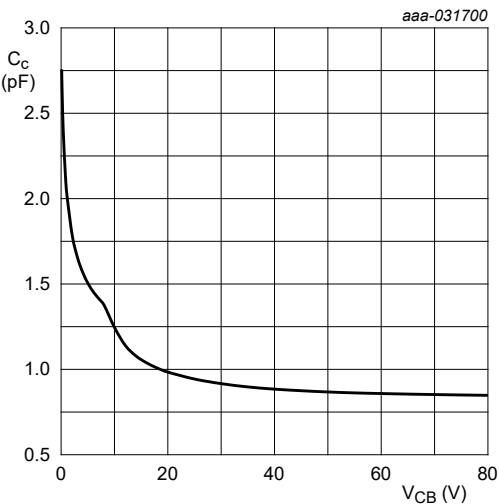


Fig. 7. NHDTC114ET-Q: Off-state input voltage as a function of collector current; typical values



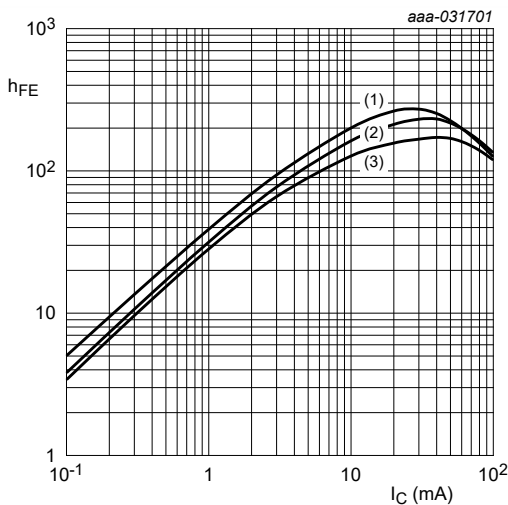
$I_C/I_B = 20$
(1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
(2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
(3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



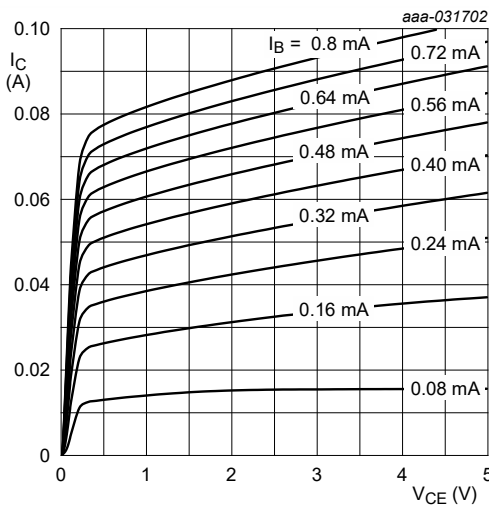
$f = 1\text{ MHz}$
 $T_{amb} = 25\text{ }^{\circ}\text{C}$

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



$V_{CE} = 5\text{ V}$
(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. 10. NHDTC124ET-Q: DC current gain as a function of collector current; typical values



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

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

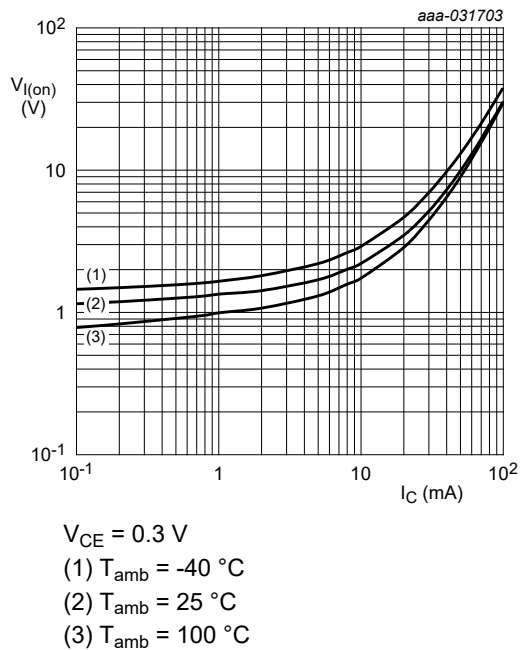


Fig. 12. NHDTC124ET-Q: On-state input voltage as a function of collector current; typical values

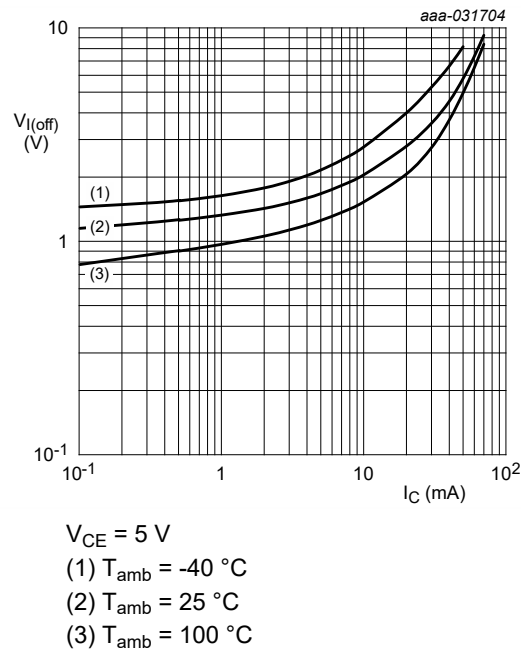


Fig. 13. NHDTC124ET-Q: Off-state input voltage as a function of collector current; typical values

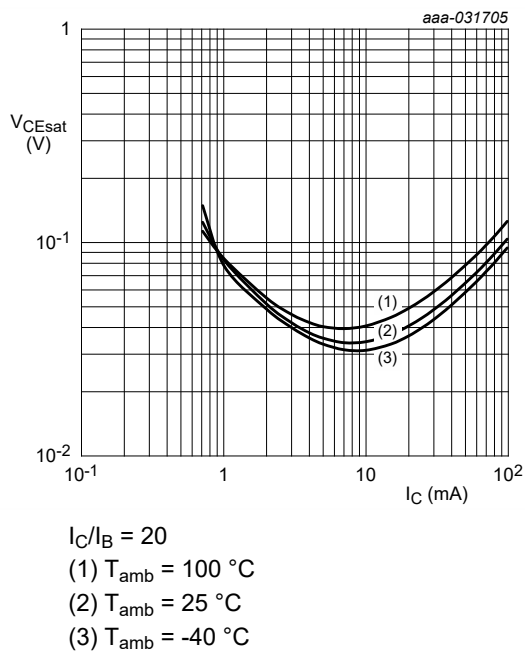


Fig. 14. NHDTC124ET-Q: Collector-emitter saturation voltage as a function of collector current; typical values

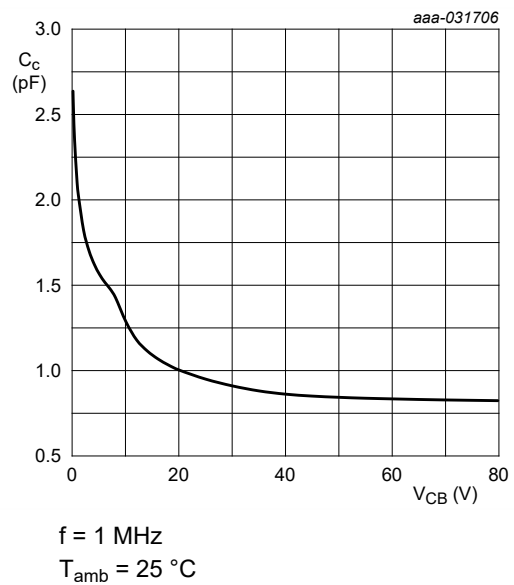


Fig. 15. NHDTC124ET-Q: Collector capacitance as a function of collector-base voltage; typical values

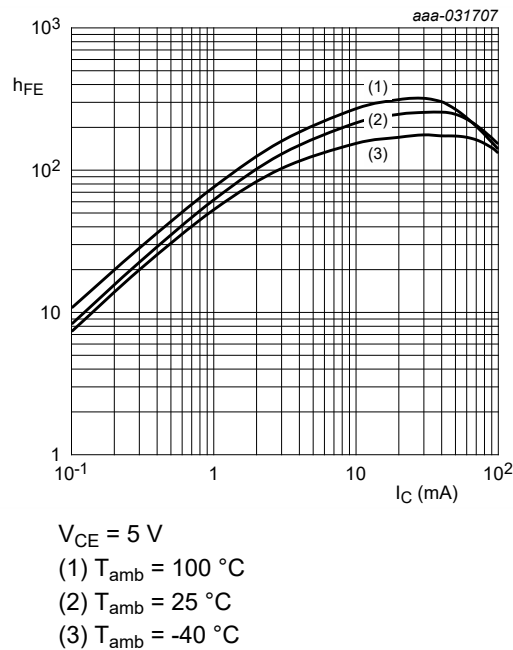


Fig. 16. NHDTC144ET-Q: DC current gain as a function of collector current; typical values

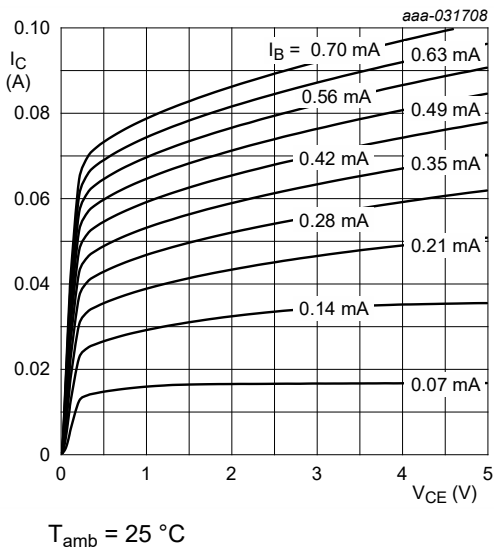


Fig. 17. NHDTC144ET-Q: Collector current as a function of collector-emitter voltage; typical values

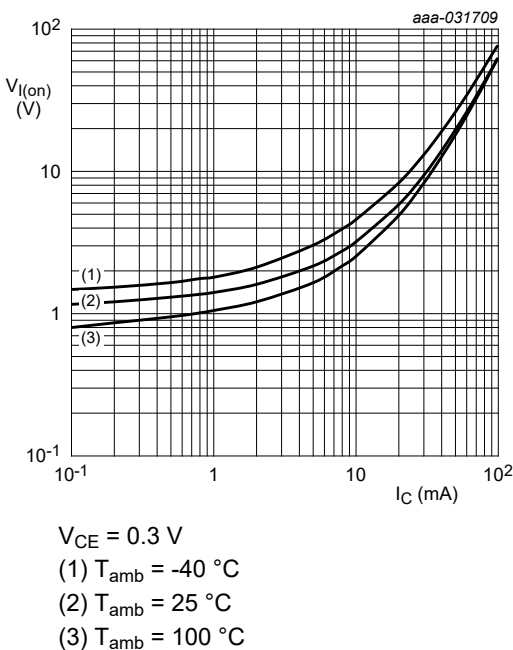


Fig. 18. NHDTC144ET-Q: On-state input voltage as a function of collector current; typical values

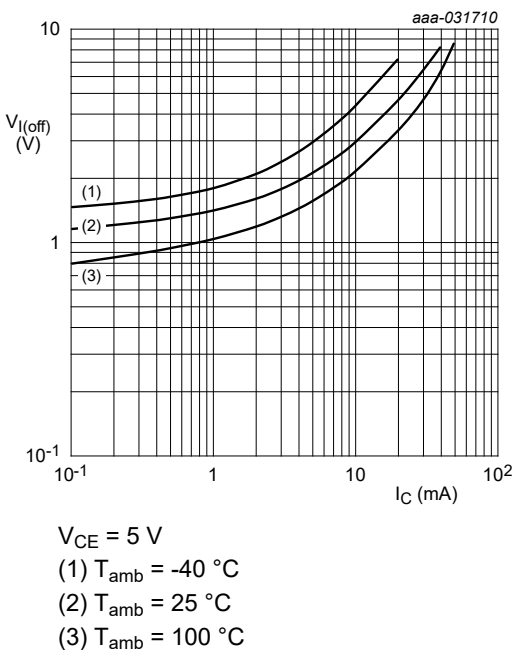
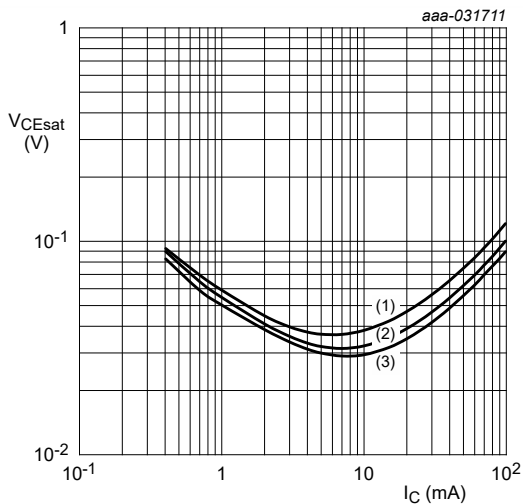
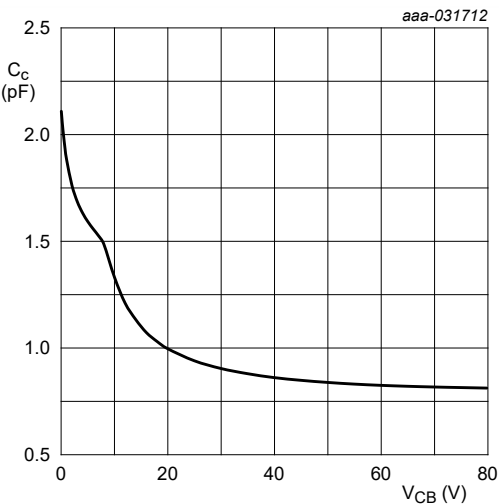


Fig. 19. NHDTC144ET-Q: Off-state input voltage as a function of collector current; typical values



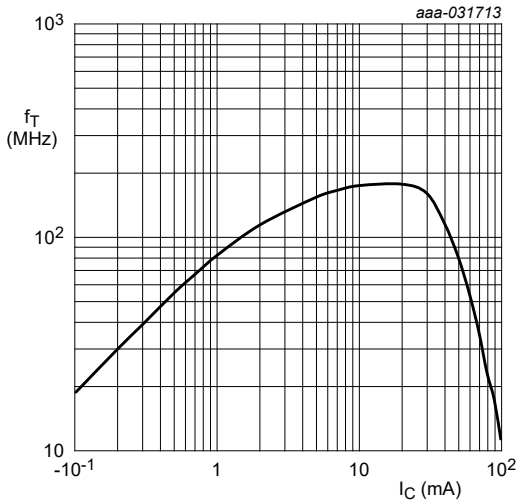
$I_C/I_B = 20$
(1) $T_{amb} = 100\text{ °C}$
(2) $T_{amb} = 25\text{ °C}$
(3) $T_{amb} = -40\text{ °C}$

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



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

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



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

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)

$$R_I = \frac{V(I_2) - V(I_I)}{I_2 - I_I}$$
- Calculation of bias resistor ratio (R2/R1)

$$\frac{R2}{R1} = \frac{V(I_4) - V(I_3)}{R1 \cdot (I_4 - I_3)} - 1$$

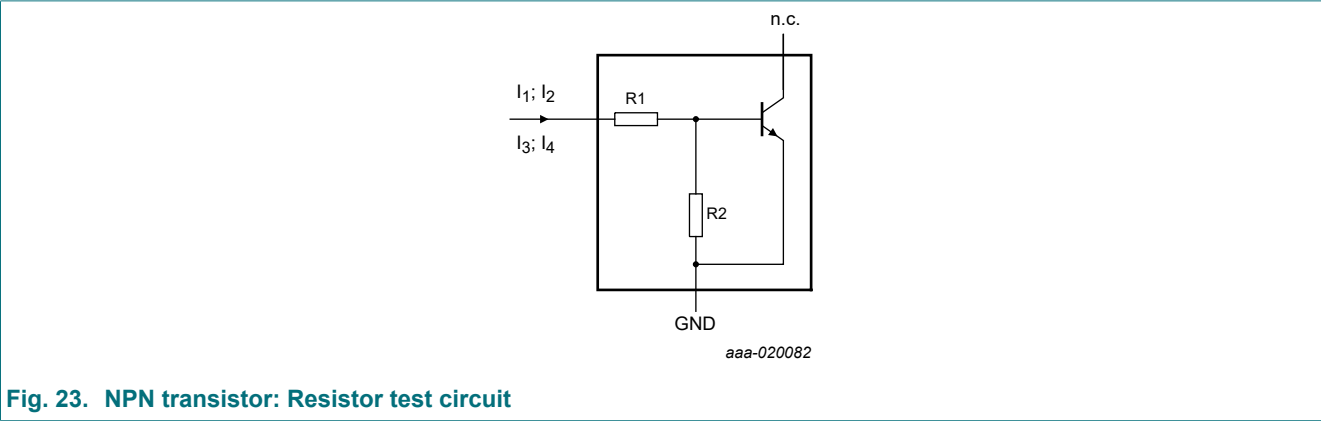


Fig. 23. NPN transistor: Resistor test circuit

Resistor test conditions

Table 9. Resistor test conditions

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

12. Package outline

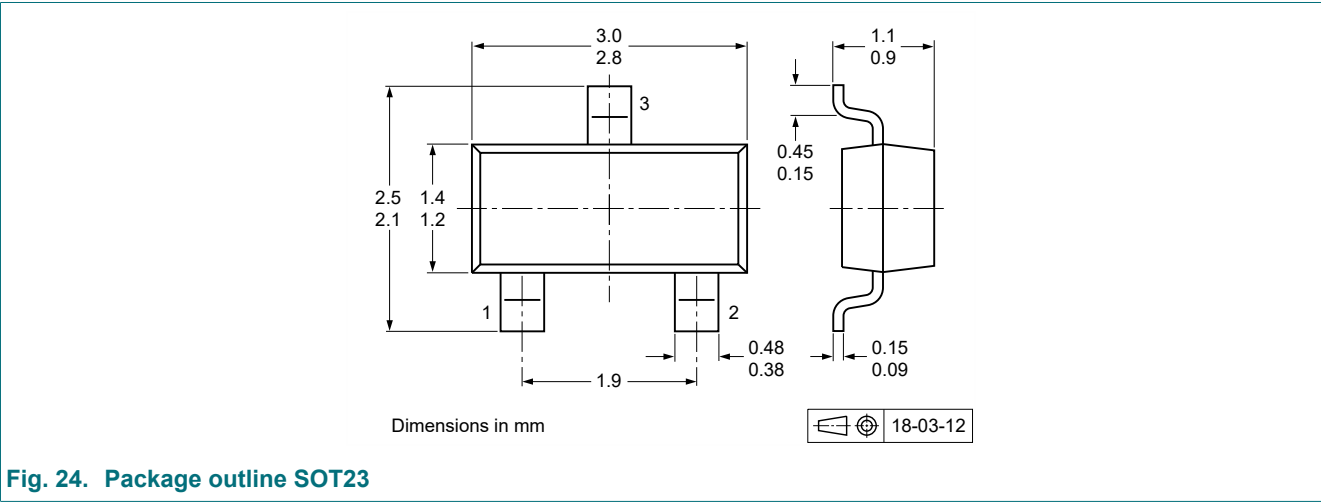


Fig. 24. Package outline SOT23

13. Soldering

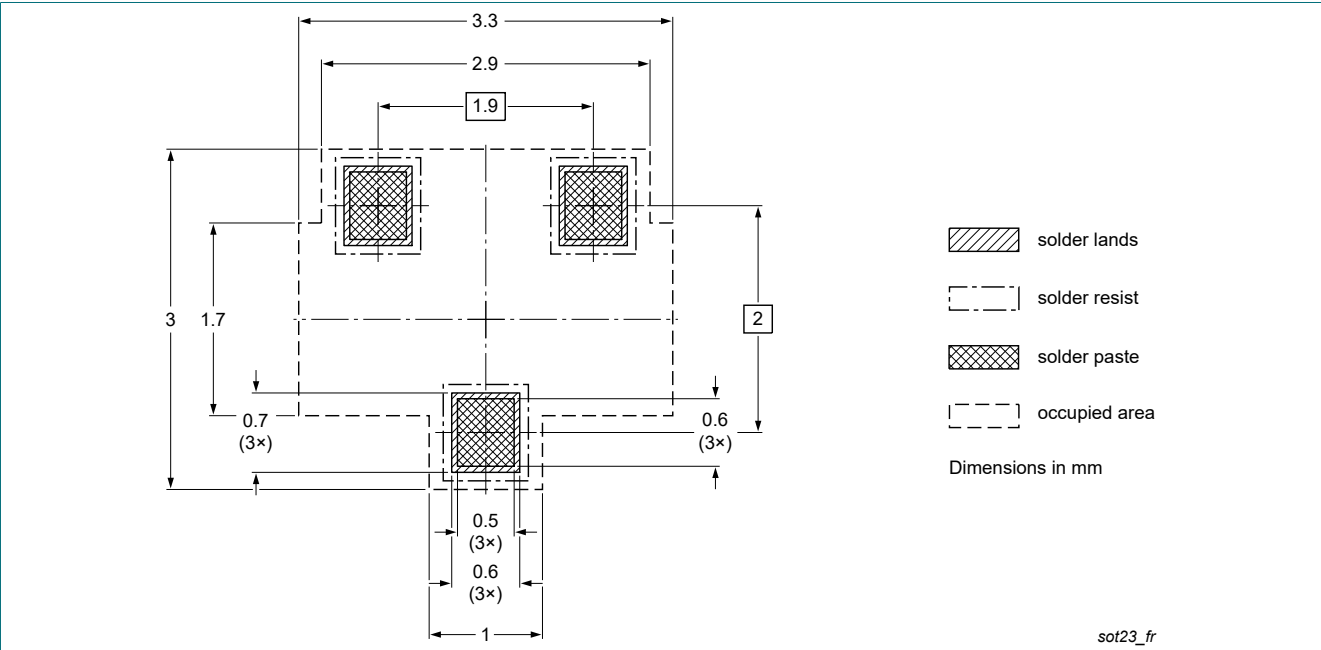


Fig. 25. Reflow soldering footprint for SOT23

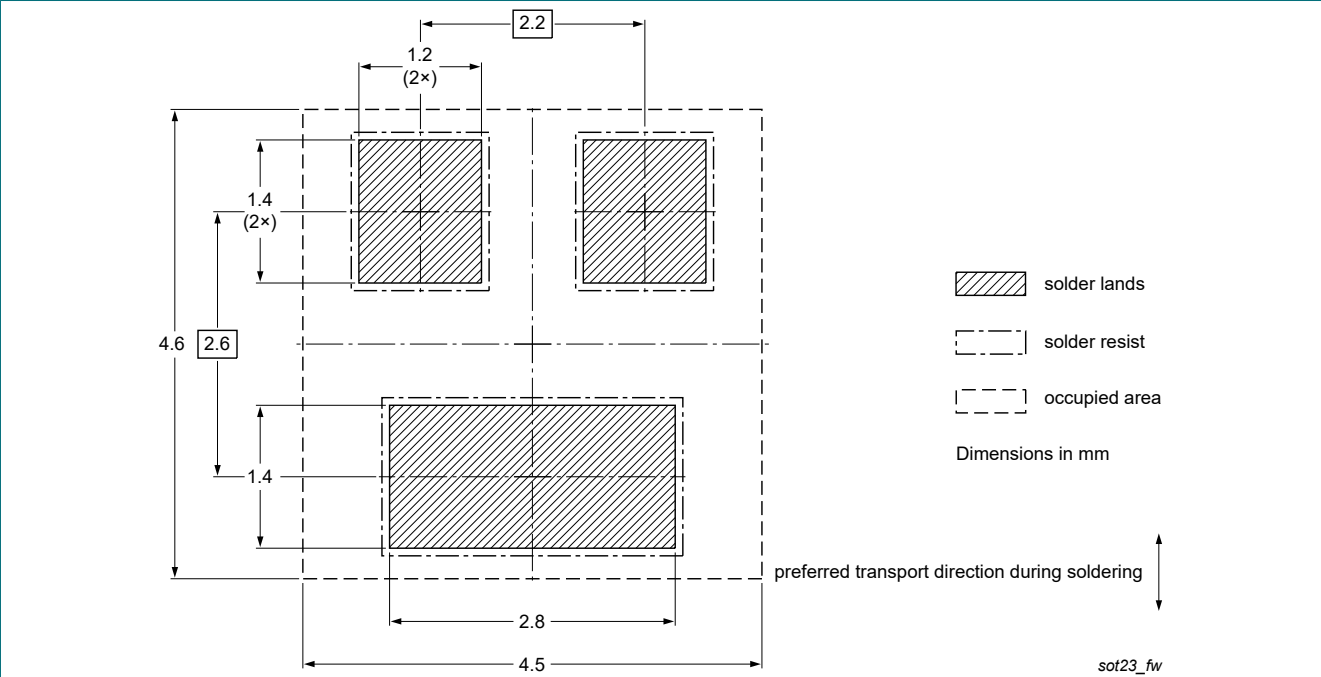


Fig. 26. Wave soldering footprint for SOT23

14. Revision history

Table 10. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NHDTC114_124_144ET-Q_SER v.1	20241017	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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