



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:
	k Ω	k Ω	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

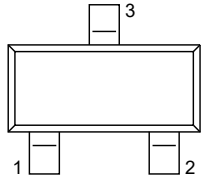
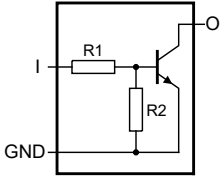
Table 2. Quick reference data

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

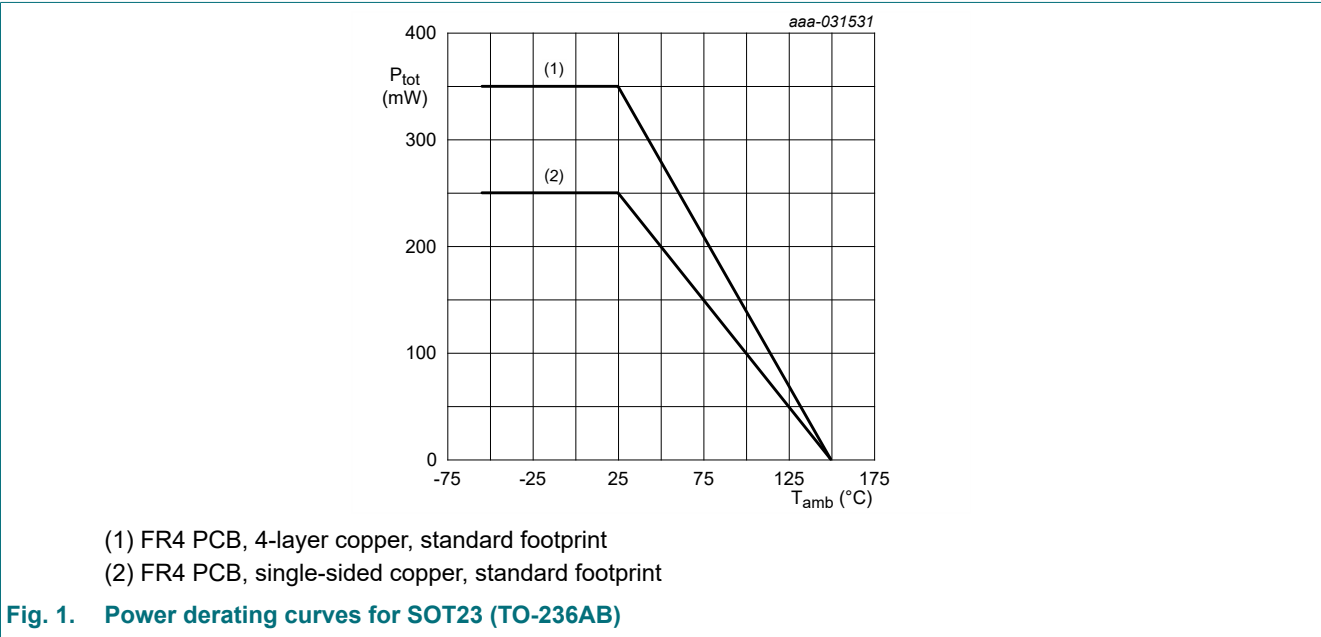
In accordance with the Absolute Maximum Rating System (IEC 60134).

$T_{amb} = 25\text{ °C}$ 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				
	NHDTC114ET		-10	+40	V
	NHDTC124ET		-10	+60	V
	NHDTC144ET		-10	+80	V
I_O	output current		-	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ °C}$ [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.

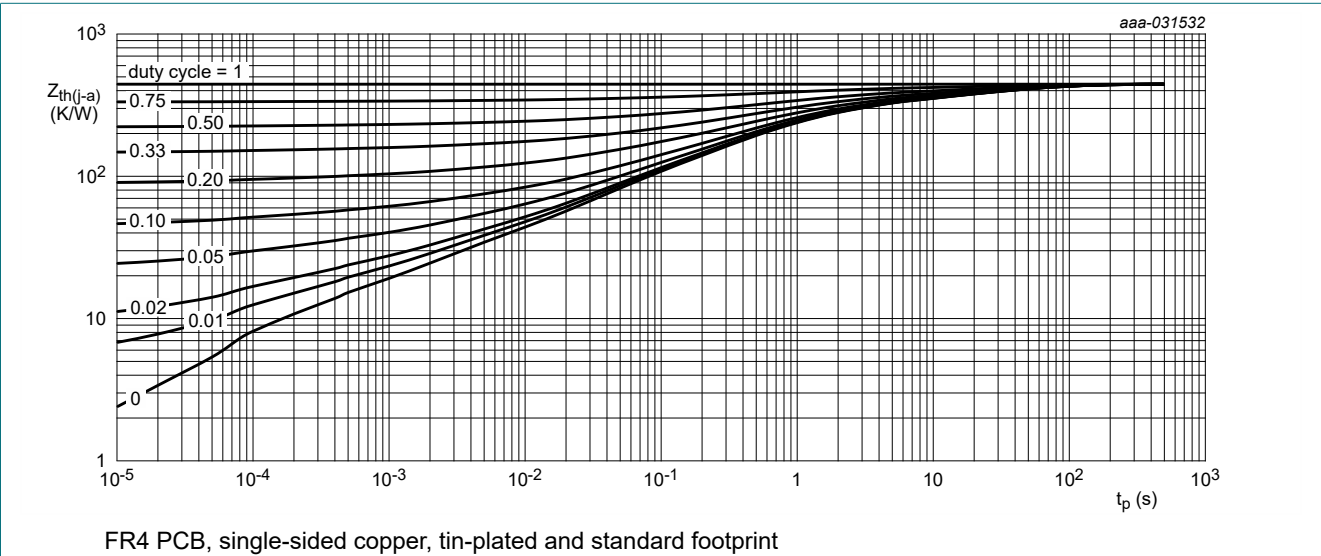


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

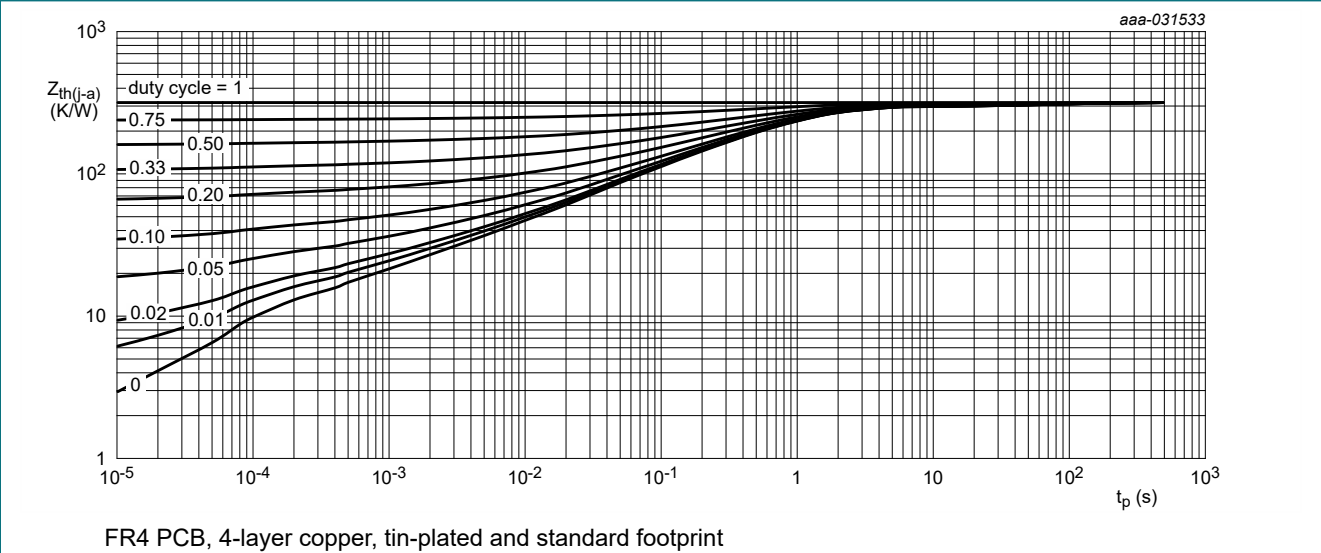


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 8. Characteristics

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

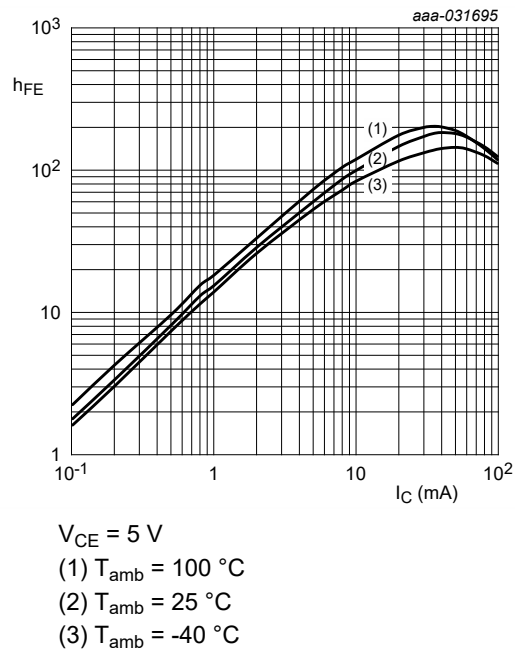


Fig. 4. NHDTC114ET: DC current gain as a function of collector current; typical values

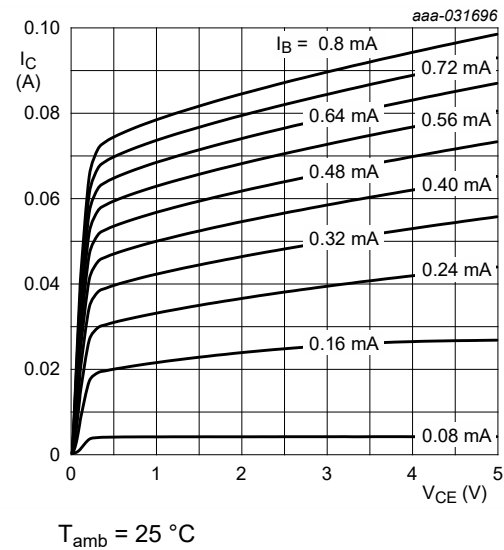


Fig. 5. NHDTC114ET: Collector current as a function of collector-emitter voltage; typical values

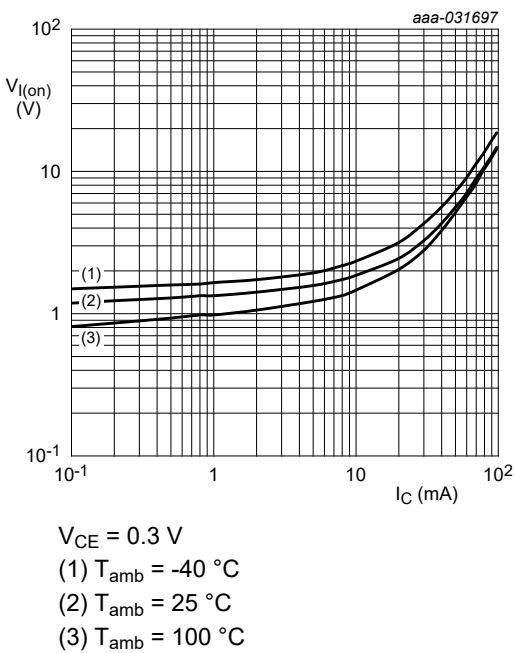


Fig. 6. NHDTC114ET: On-state input voltage as a function of collector current; typical values

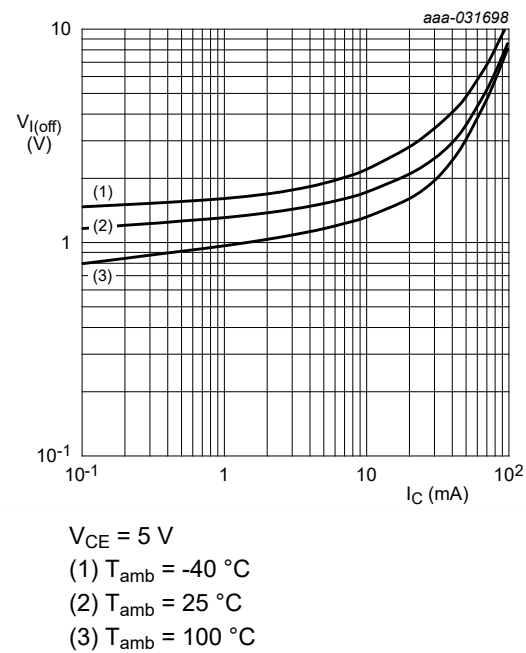
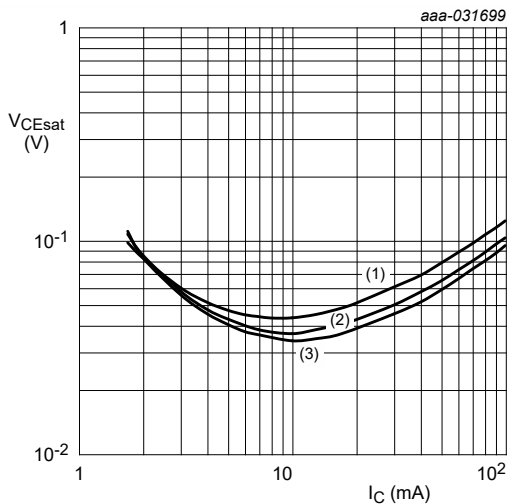
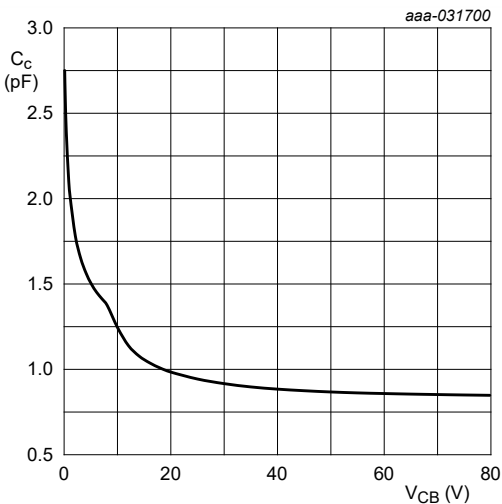


Fig. 7. NHDTC114ET: Off-state input voltage as a function of collector current; typical values



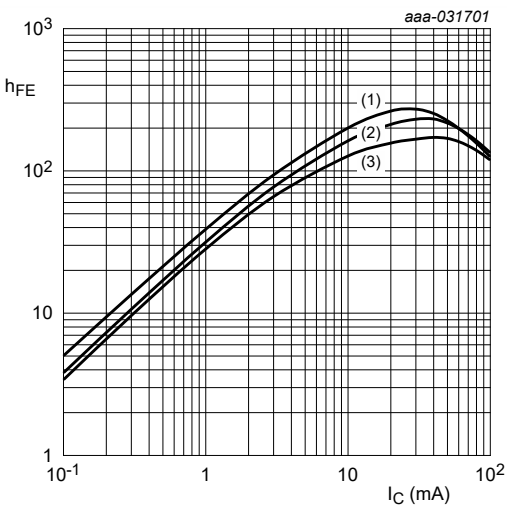
$I_C/I_B = 20$
(1) $T_{amb} = 100\text{ }^{\circ}\text{C}$
(2) $T_{amb} = 25\text{ }^{\circ}\text{C}$
(3) $T_{amb} = -40\text{ }^{\circ}\text{C}$

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



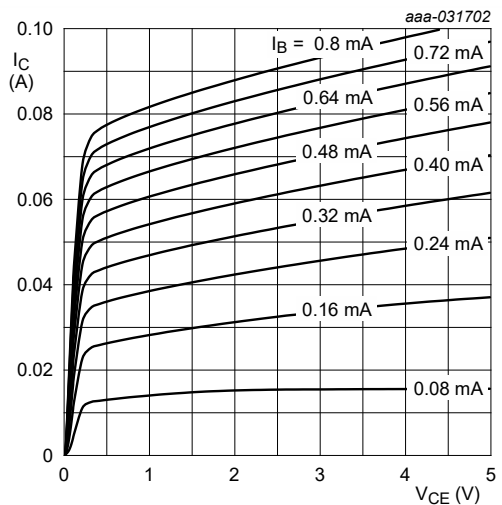
$f = 1\text{ MHz}$
 $T_{amb} = 25\text{ }^{\circ}\text{C}$

Fig. 9. NHDTC114ET: 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: DC current gain as a function of collector current; typical values



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

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

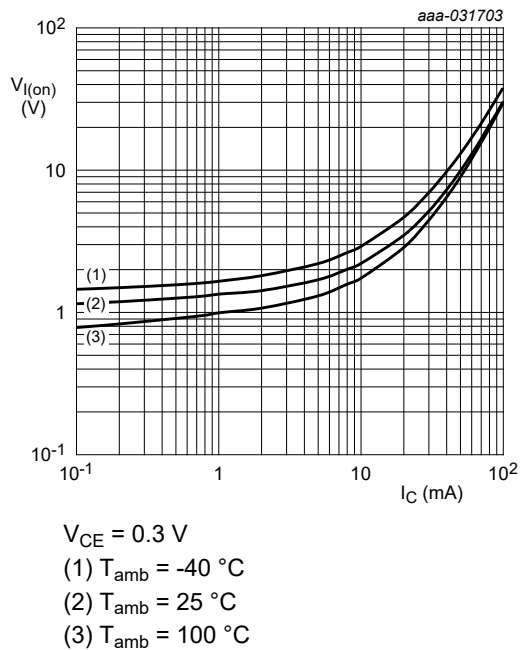


Fig. 12. NHDTC124ET: On-state input voltage as a function of collector current; typical values

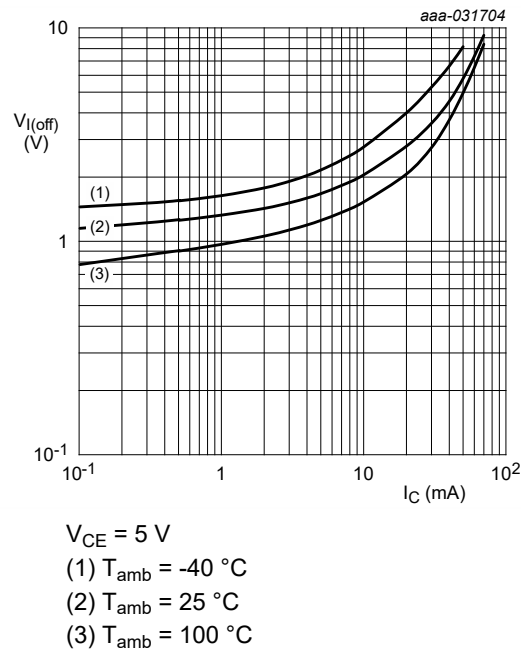


Fig. 13. NHDTC124ET: Off-state input voltage as a function of collector current; typical values

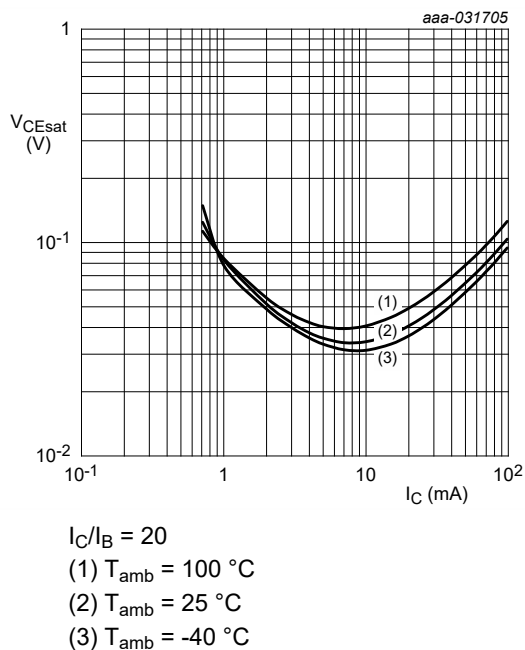


Fig. 14. NHDTC124ET: Collector-emitter saturation voltage as a function of collector current; typical values

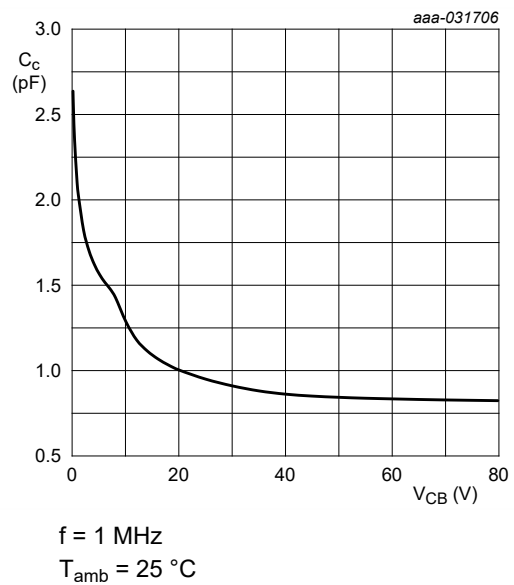


Fig. 15. NHDTC124ET: Collector capacitance as a function of collector-base voltage; typical values

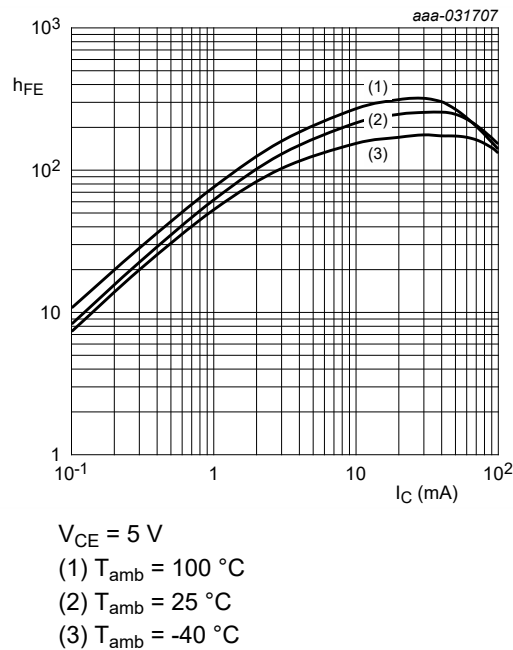


Fig. 16. NHDTC144ET: DC current gain as a function of collector current; typical values

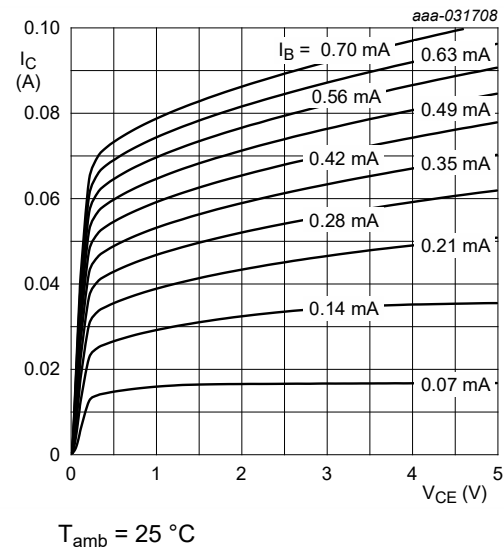


Fig. 17. NHDTC144ET: Collector current as a function of collector-emitter voltage; typical values

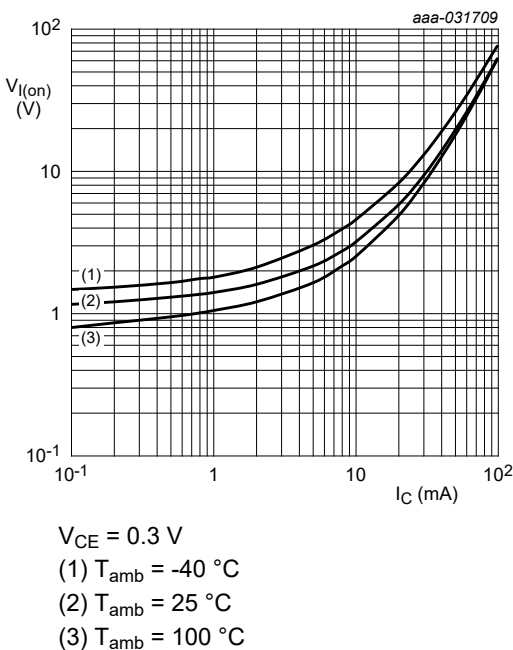


Fig. 18. NHDTC144ET: On-state input voltage as a function of collector current; typical values

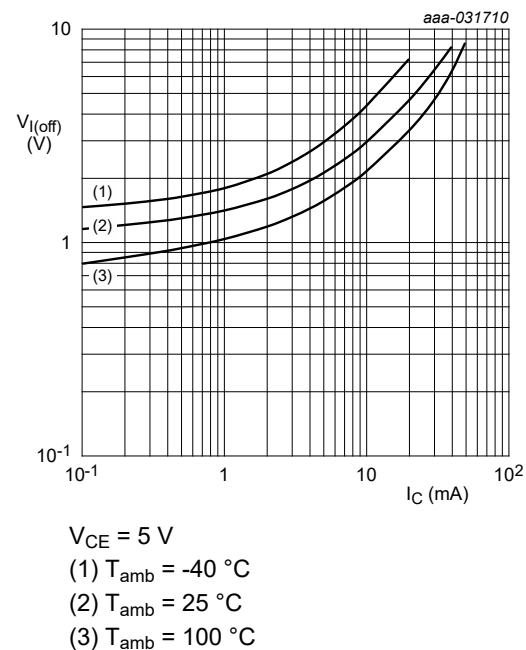


Fig. 19. NHDTC144ET: Off-state input voltage as a function of collector current; typical values

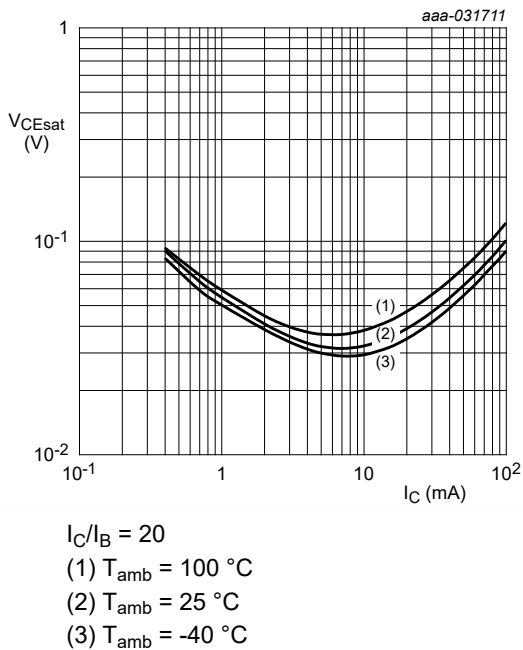


Fig. 20. NHDTC144ET: Collector-emitter saturation voltage as a function of collector current; typical values

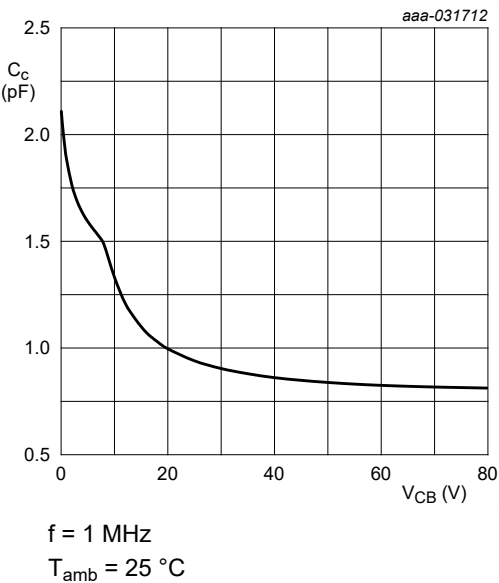
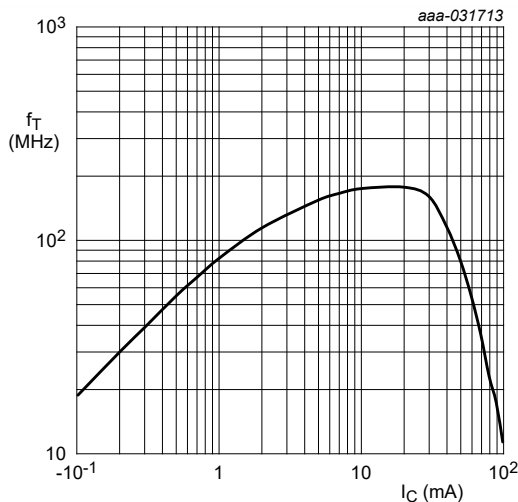


Fig. 21. NHDTC144ET: Collector capacitance as a function of collector-base voltage; typical values



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

Fig. 22. Transition frequency as a function of collector current; typical values of built-in transistor

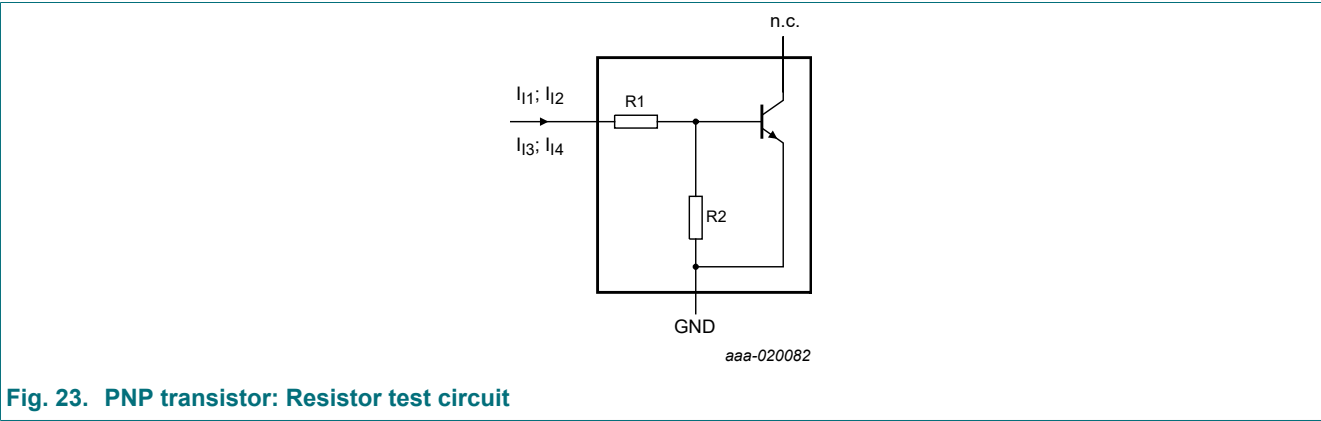
11. Test information

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)
$$R1 = \frac{V(I_{I2}) - V(I_{I1})}{I_{I2} - I_{I1}}$$
- Calculation of bias resistor ratio (R2/R1)
$$\frac{R2}{R1} = \frac{V(I_{I4}) - V(I_{I3})}{R1 \cdot (I_{I4} - I_{I3})} - 1$$



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

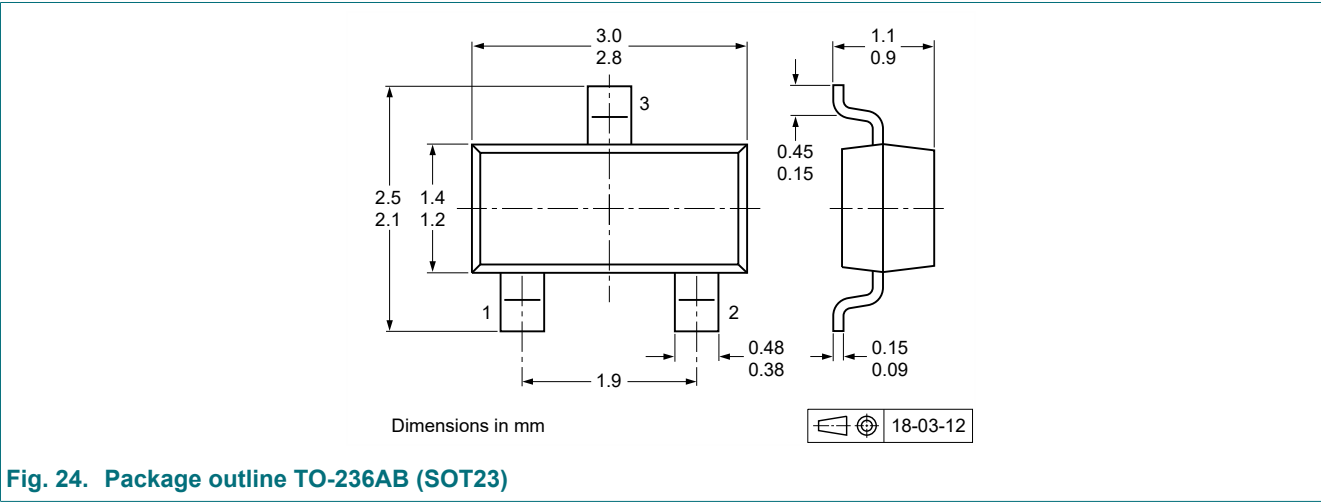


Fig. 24. Package outline TO-236AB (SOT23)

13. Soldering

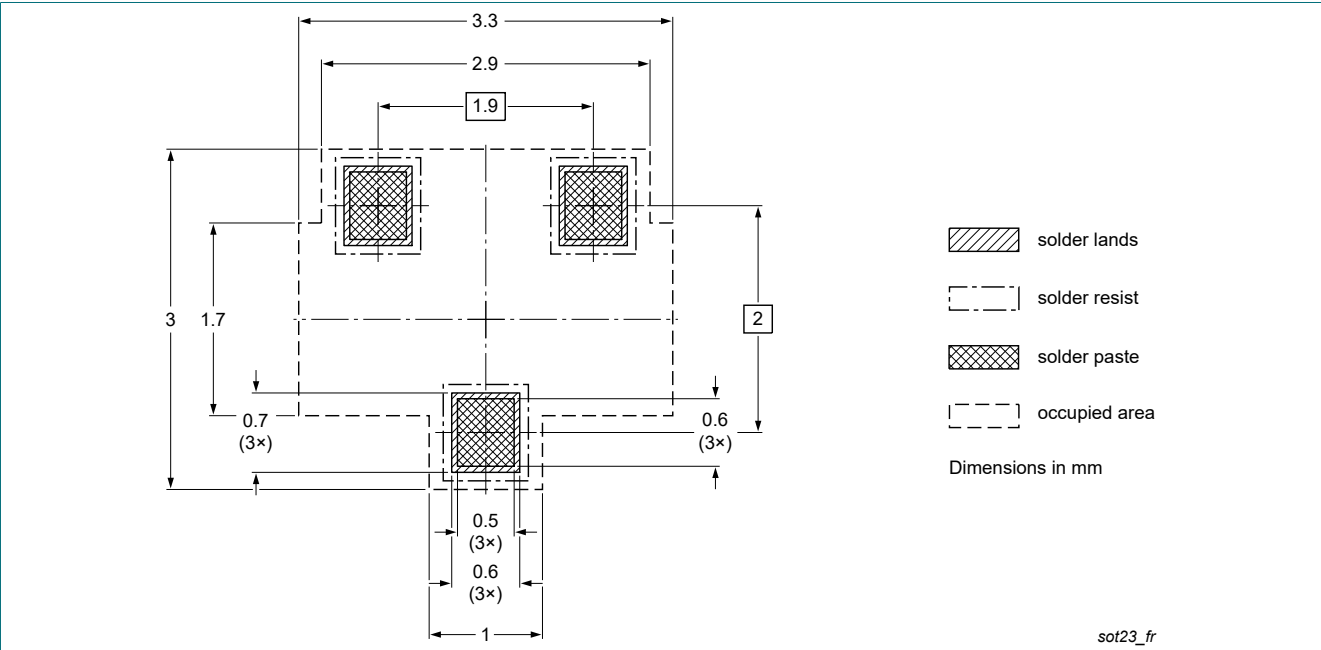


Fig. 25. Reflow soldering footprint for TO-236AB (SOT23)

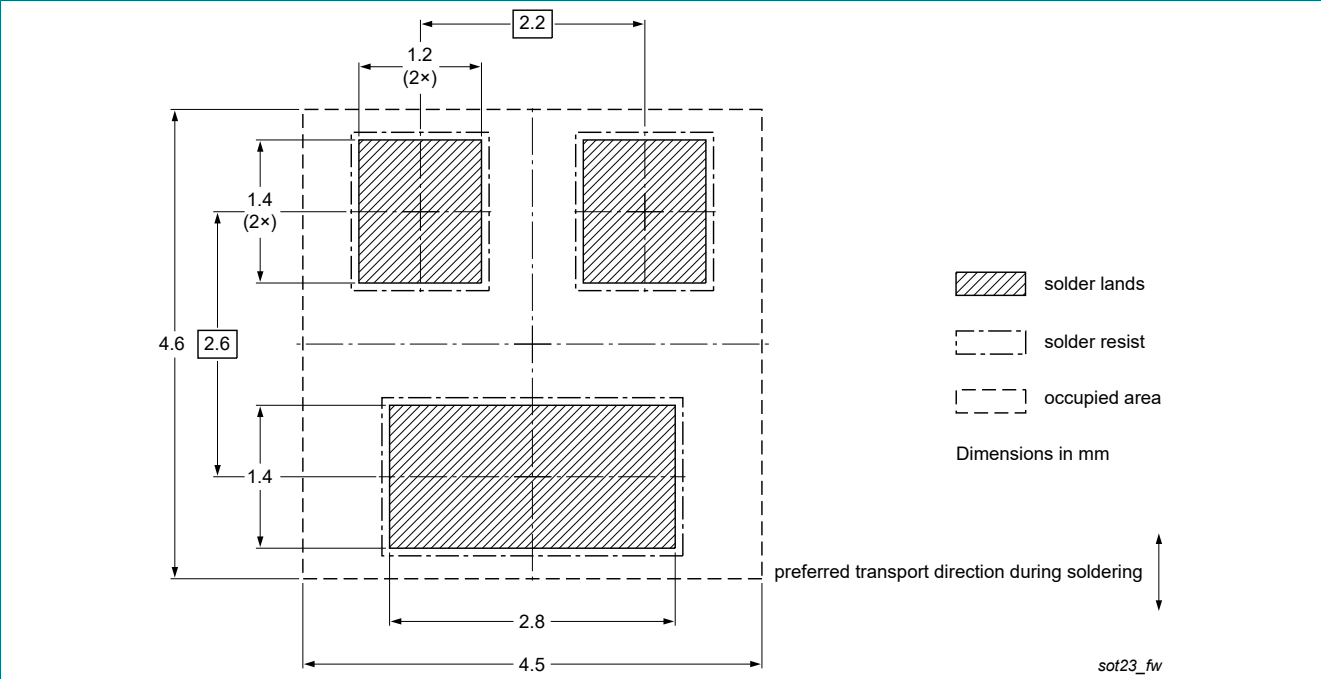


Fig. 26. Wave soldering footprint for TO-236AB (SOT23)

14. Revision history

Table 10. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NHDT C114_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.

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Date of release: 26 June 2020

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