PDTB1xxxU series

500 mA, 50 V PNP resistor-equipped transistors

Rev. 1 — 6 May 2014 Product data sheet

1. Product profile

1.1 General description

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

Table 1. Product overview

Type number	Package			NPN complement	Package configuration
	Nexperia	JEITA	JEDEC		
PDTB113EU	SOT323	SC-70	-	PDTD113EU	very small
PDTB113ZU				PDTD113ZU	
PDTB123EU				PDTD123EU	
PDTB123YU				PDTD123YU	
PDTB143EU				PDTD143EU	
PDTB143XU				PDTD143XU	
PDTB114EU				PDTD114EU	

1.2 Features

- 500 mA output current capability
- Built-in bias resistors
- Simplifies circuit design
- Reduces component count
- ± 10 % resistor ratio tolerance
- AEC-Q101 qualified
- High temperature applications up to 175 °C

1.3 Applications

- IC inputs control
- Cost-saving alternative to BC807 or BC817 series transistors in digital applications
- Switching loads

nexperia

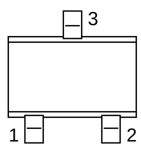
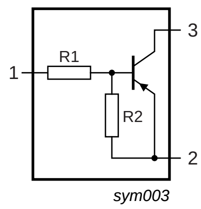
1.4 Quick reference data

Table 2. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CEO}	collector-emitter voltage	open base	-	-	–50	V
I_O	output current		-	-	–500	mA
R1	bias resistor 1 (input)					
	PDTB113EU			1		kΩ
	PDTB113ZU			1		kΩ
	PDTB123EU			2.2		kΩ
	PDTB123YU			2.2		kΩ
	PDTB143EU			4.7		kΩ
	PDTB143XU			4.7		kΩ
	PDTB114EU			10		kΩ
R2	bias resistor 2 (base-emitter)					
	PDTB113EU			1		kΩ
	PDTB113ZU			10		kΩ
	PDTB123EU			2.2		kΩ
	PDTB123YU			10		kΩ
	PDTB143EU			4.7		kΩ
	PDTB143XU			10		kΩ
	PDTB114EU			10		kΩ

2. Pinning information

Table 3. Pinning

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

3. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
PDTB1xxxU series	SC-70	plastic surface-mounted package; 3 leads	SOT323

4. Marking

Table 5. Marking codes

Type number	Marking code[1]
PDTB113EU	ZG*
PDTB113ZU	ZH*
PDTB123EU	ZJ*
PDTB123YU	ZK*
PDTB143EU	ZL*
PDTB143XU	ZM*
PDTB114EU	ZN*

[1] * = placeholder for manufacturing site code

5. Limiting values

Table 6. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	–50	V
V_{CEO}	collector-emitter voltage	open base	-	–50	V
V_{EBO}	emitter-base voltage	open collector			
	PDTB113EU		-	–10	V
	PDTB113ZU		-	–5	V
	PDTB123EU		-	–10	V
	PDTB123YU		-	–5	V
	PDTB143EU		-	–10	V
	PDTB143XU		-	–7	V
	PDTB114EU		-	–10	V
V_I	input voltage				
	PDTB113EU		–10	+10	V
	PDTB113ZU		–10	+5	V
	PDTB123EU		–12	+10	V
	PDTB123YU		–12	+5	V
	PDTB143EU		–30	+10	V
	PDTB143XU		–30	+7	V
	PDTB114EU		–50	+10	V
I_O	output current		-	–500	mA

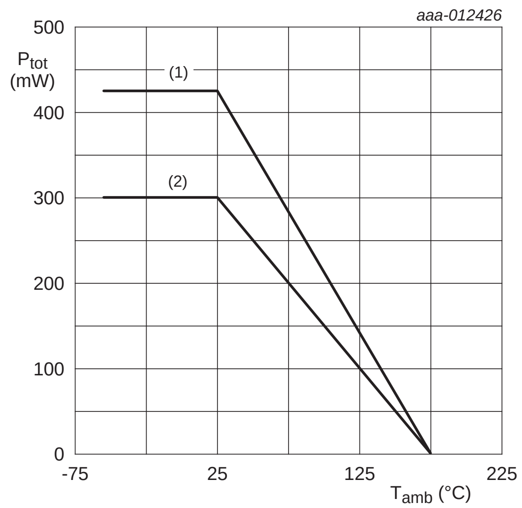
Table 6. Limiting values *...continued*

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

Symbol	Parameter	Conditions		Min	Max	Unit
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	300	mW
			[2]	-	425	mW
T_j	junction temperature			-	175	°C
T_{amb}	ambient temperature			–55	+175	°C
T_{stg}	storage temperature			–55	+175	°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 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

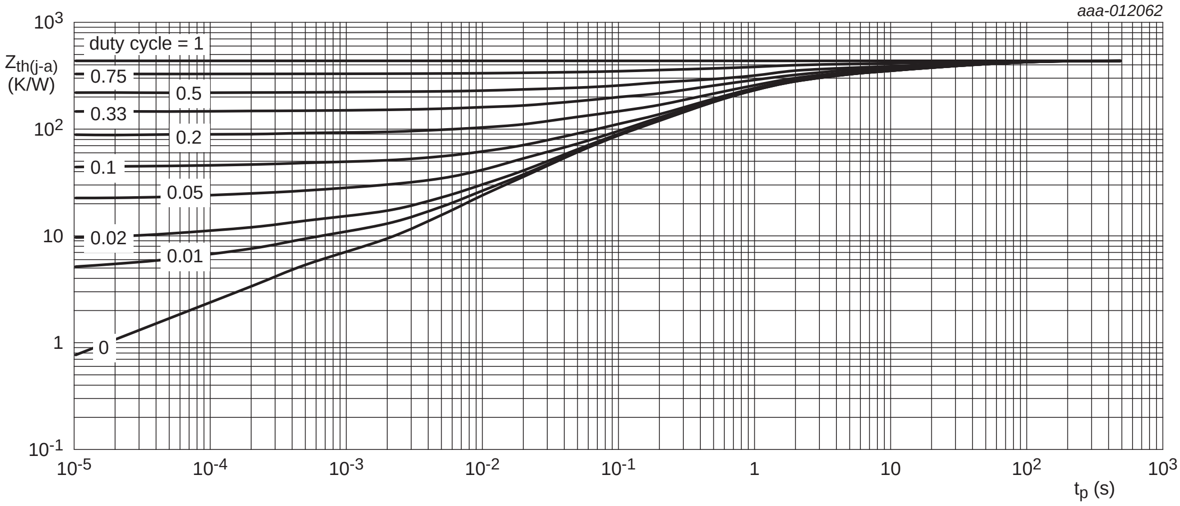
6. Thermal characteristics

Table 7. Thermal characteristics

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]	-	-	353	K/W

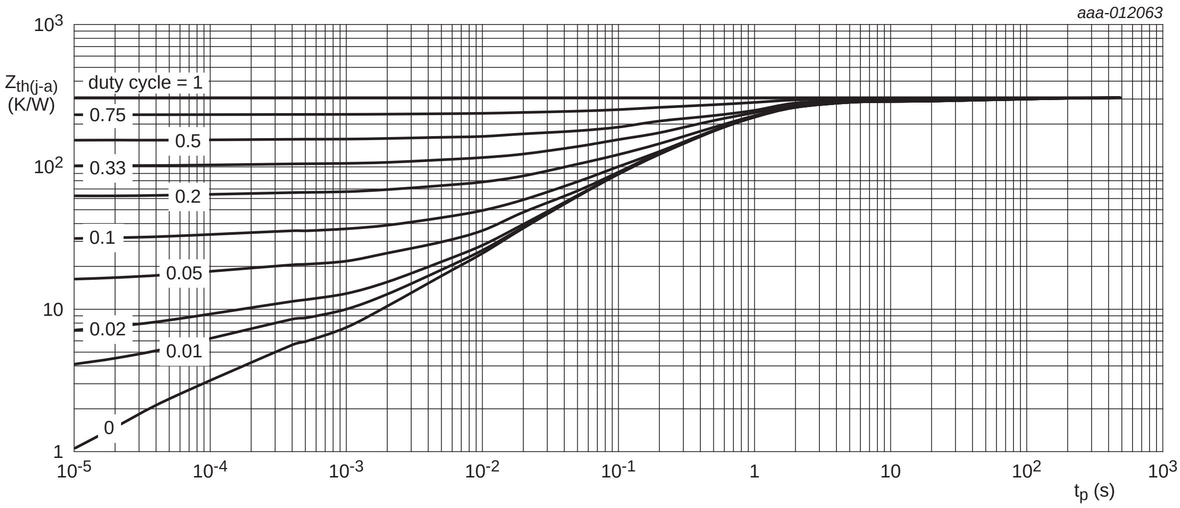
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 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 for SOT323/SC-70; 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 for SOT323/SC-70; typical values

7. Characteristics

Table 8. Characteristics

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

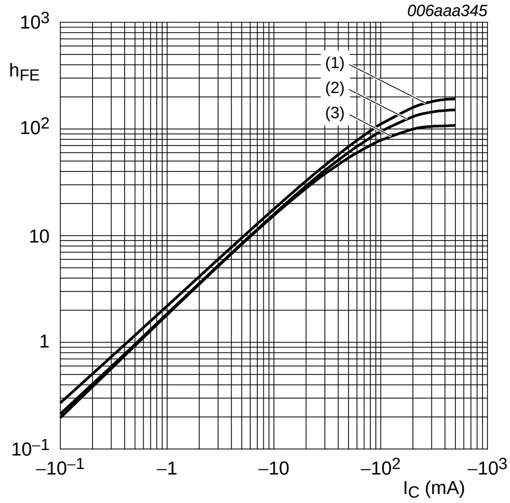
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	V_{CB} = –40 V; I_E = 0 A	-	-	–100	nA
		V_{CB} = –50 V; I_E = 0 A	-	-	–100	nA
I_{CEO}	collector-emitter cut-off current	V_{CE} = –50 V; I_B = 0 A	-	-	–0.5	µA
I_{EBO}	emitter-base cut-off current	V_{EB} = –5 V; I_C = 0 A				
	PDTB113EU		-	-	–4.0	mA
	PDTB113ZU		-	-	–0.8	mA
	PDTB123EU		-	-	–2.0	mA
	PDTB123YU		-	-	–0.65	mA
	PDTB143EU		-	-	–0.9	mA
	PDTB143XU		-	-	–0.6	mA
	PDTB114EU		-	-	–0.4	mA
h_{FE}	DC current gain	V_{CE} = –5 V; I_C = –50 mA				
	PDTB113EU		33	-	-	
	PDTB113ZU		70	-	-	
	PDTB123EU		40	-	-	
	PDTB123YU		70	-	-	
	PDTB143EU		60	-	-	
	PDTB143XU		70	-	-	
	PDTB114EU		70	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = –50 mA; I_B = –2.5 mA	-	-	–100	mV
$V_{I(off)}$	off-state input voltage	V_{CE} = –5 V; I_C = –100 µA				
	PDTB113EU		–0.6	–1.0	–1.5	V
	PDTB113ZU		–0.3	–0.6	–1.0	V
	PDTB123EU		–0.6	–1.1	–1.8	V
	PDTB123YU		–0.4	–0.65	–1.0	V
	PDTB143EU		–0.6	–0.9	–1.5	V
	PDTB143XU		–0.5	–0.75	–1.1	V
	PDTB114EU		–0.6	–1.0	–1.5	V
$V_{I(on)}$	on-state input voltage	V_{CE} = –0.3 V; I_C = –20 mA				
	PDTB113EU		–1.0	–1.4	–1.8	V
	PDTB113ZU		–0.4	–0.8	–1.4	V
	PDTB123EU		–1.0	–1.5	–2.0	V
	PDTB123YU		–0.5	–1.0	–1.4	V
	PDTB143EU		–1.0	–1.7	–2.2	V
	PDTB143XU		–1.0	–1.4	–2.0	V
	PDTB114EU		–1.0	–2.2	–3.0	V

Table 8. Characteristics *...continued*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R1	bias resistor 1 (input)					
	PDTB113EU		0.7	1.0	1.3	kΩ
	PDTB113ZU		0.7	1.0	1.3	kΩ
	PDTB123EU		1.54	2.2	2.86	kΩ
	PDTB123YU		1.54	2.2	2.86	kΩ
	PDTB143EU		3.3	4.7	6.1	kΩ
	PDTB143XU		3.3	4.7	6.1	kΩ
	PDTB114EU		7.0	10	13	kΩ
R2/R1	bias resistor ratio					
	PDTB113EU		0.9	1.0	1.1	
	PDTB113ZU		9.0	10	11	
	PDTB123EU		0.9	1.0	1.1	
	PDTB123YU		4.1	4.55	5.0	
	PDTB143EU		0.9	1	1.1	
	PDTB143XU		1.91	2.13	2.34	
	PDTB114EU		0.9	1.0	1.1	
C_c	collector capacitance	V_{CB} = −10 V; I_E = i_e = 0 A; f = 1 MHz	-	11	-	pF
f_T	transition frequency	V_{CE} = −5 V; I_C = −50 mA; f = 100 MHz [1]	-	140	-	MHz

[1] Characteristics of built-in transistor.



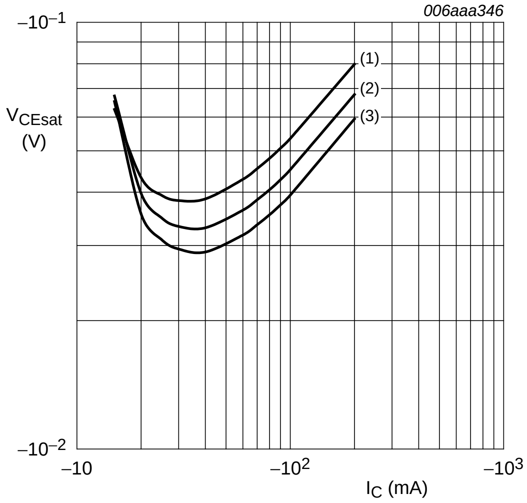
V_{CE} = –5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = –40 °C

Fig 4. PDTB113EU: DC current gain as a function of collector current; typical values



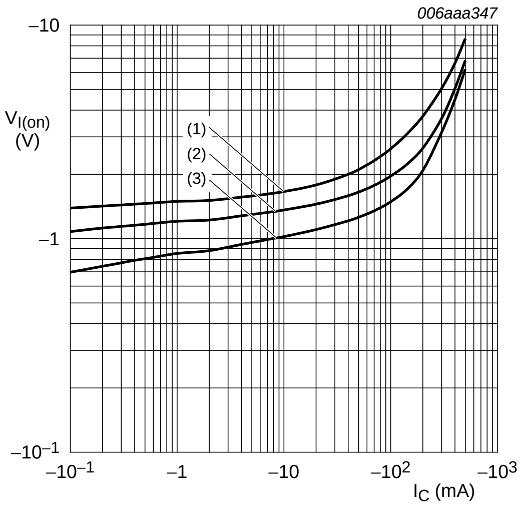
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = –40 °C

Fig 5. PDTB113EU: Collector-emitter saturation voltage as a function of collector current; typical values



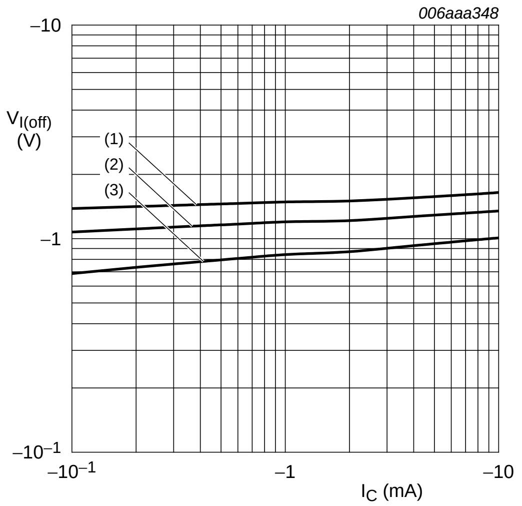
V_{CE} = –0.3 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

Fig 6. PDTB113EU: On-state input voltage as a function of collector current; typical values



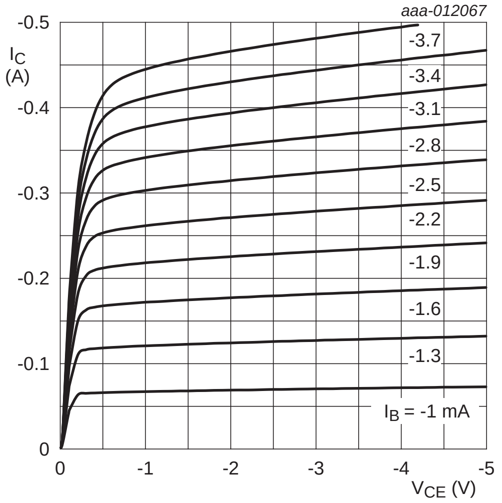
V_{CE} = –5 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

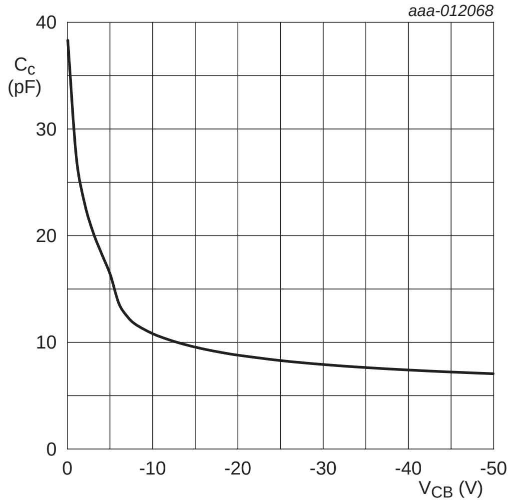
(3) T_{amb} = 100 °C

Fig 7. PDTB113EU: Off-state input voltage as a function of collector current; typical values



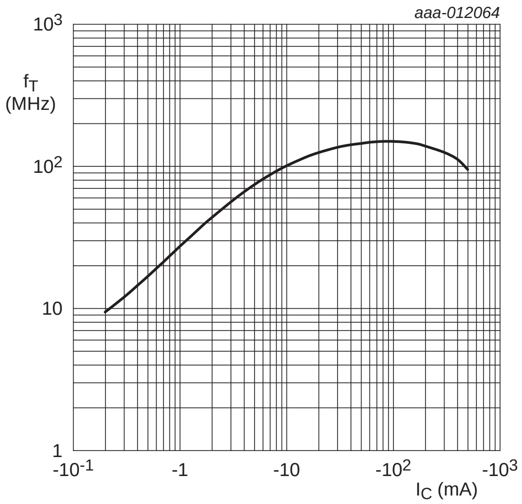
T_{amb} = 25 °C

Fig 8. PDTB113EU: Collector current as a function of collector-emitter voltage; typical values



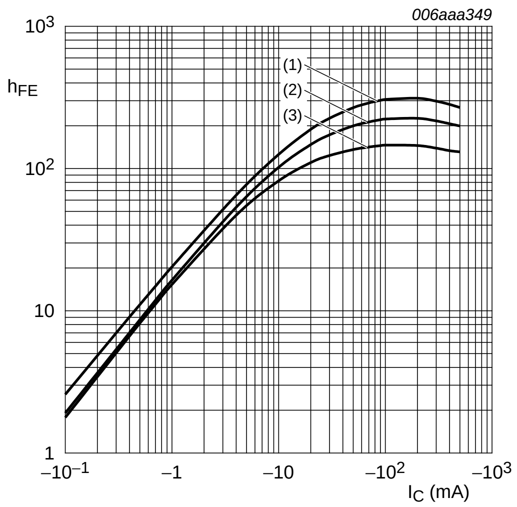
f = 1 MHz; T_{amb} = 25 °C

Fig 9. PDTB113EU: Collector capacitance as a function of collector-base voltage; typical values



V_{CE} = –5 V; T_{amb} = 25 °C

Fig 10. PDTB113EU: Transition frequency as a function of collector current; typical values of built-in transistor



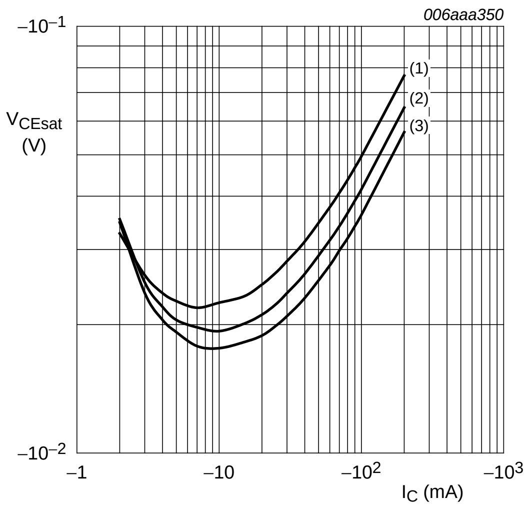
$V_{CE} = -5$ V

(1) $T_{amb} = 100$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = -40$ °C

Fig 11. PDTB113ZU: DC current gain as a function of collector current; typical values



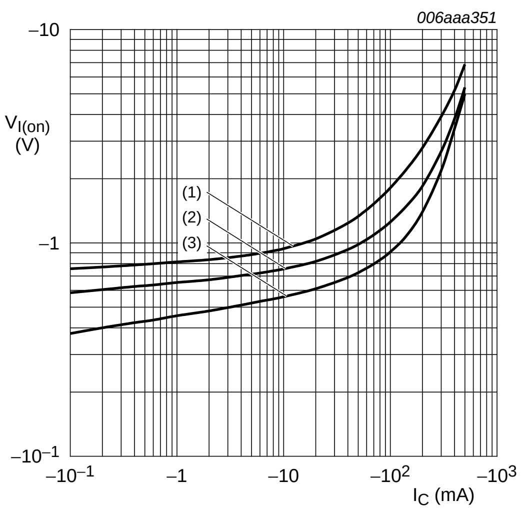
$I_C/I_B = 20$

(1) $T_{amb} = 100$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = -40$ °C

Fig 12. PDTB113ZU: Collector-emitter saturation voltage as a function of collector current; typical values



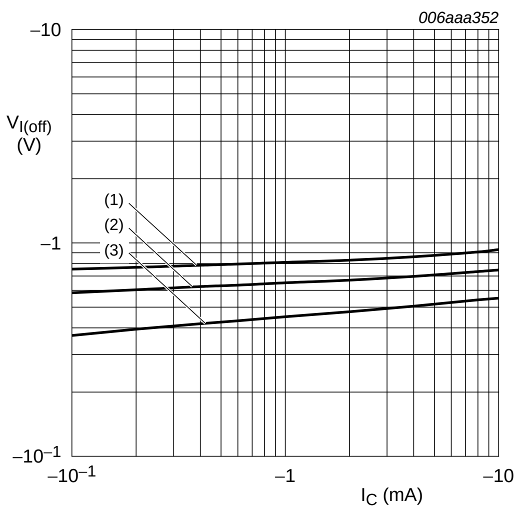
$V_{CE} = -0.3$ V

(1) $T_{amb} = -40$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = 100$ °C

Fig 13. PDTB113ZU: On-state input voltage as a function of collector current; typical values



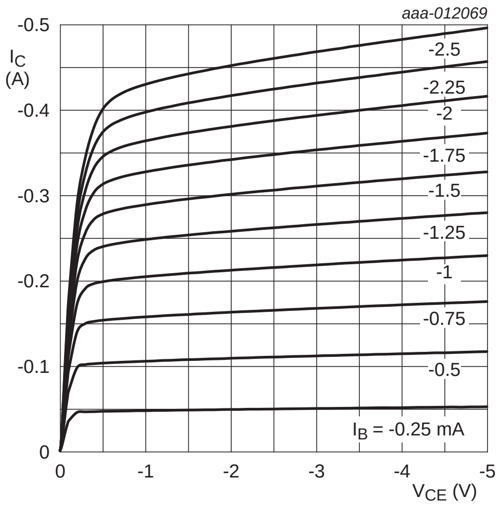
$V_{CE} = -5$ V

(1) $T_{amb} = -40$ °C

(2) $T_{amb} = 25$ °C

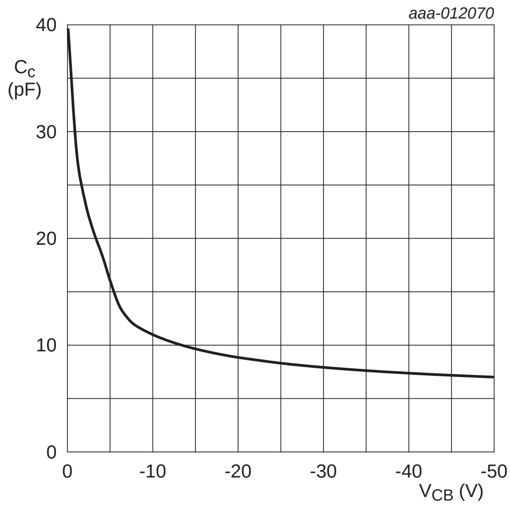
(3) $T_{amb} = 100$ °C

Fig 14. PDTB113ZU: Off-state input voltage as a function of collector current; typical values



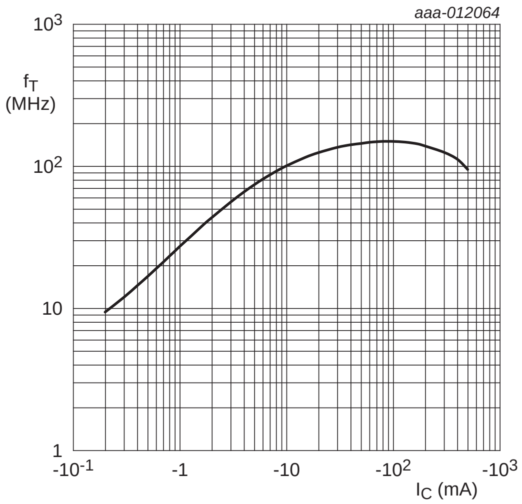
T_{amb} = 25 °C

Fig 15. PDTB113ZU: Collector current as a function of collector-emitter voltage; typical values



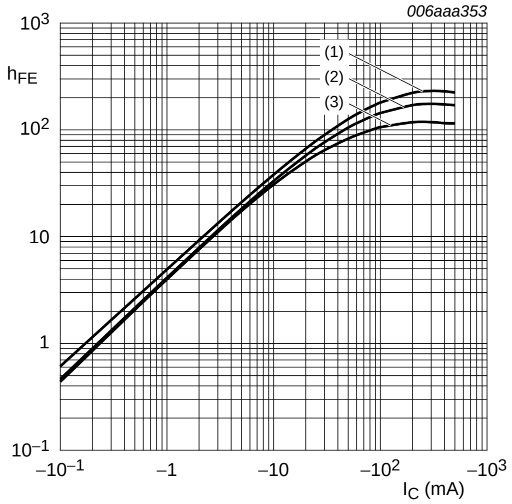
f = 1 MHz; T_{amb} = 25 °C

Fig 16. PDTB113ZU: Collector capacitance as a function of collector-base voltage; typical values



V_{CE} = –5 V; T_{amb} = 25 °C

Fig 17. PDTB113ZU: Transition frequency as a function of collector current; typical values of built-in transistor



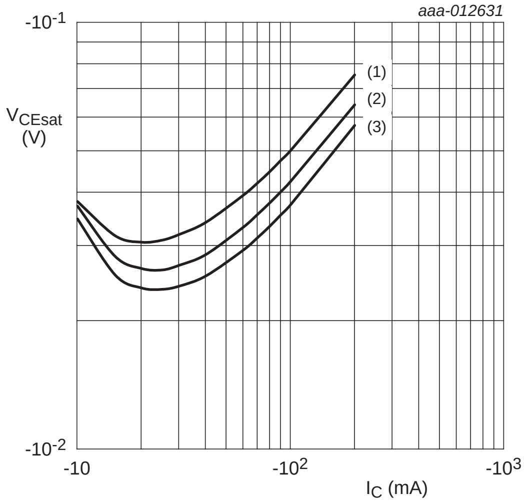
V_{CE} = –5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = –40 °C

Fig 18. PDTB123EU: DC current gain as a function of collector current; typical values



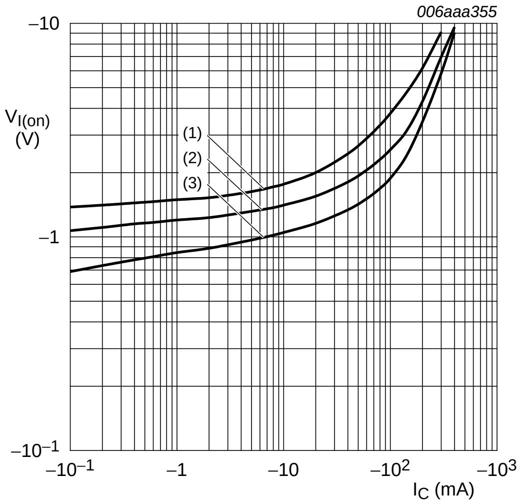
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = –40 °C

Fig 19. PDTB123EU: Collector-emitter saturation voltage as a function of collector current; typical values



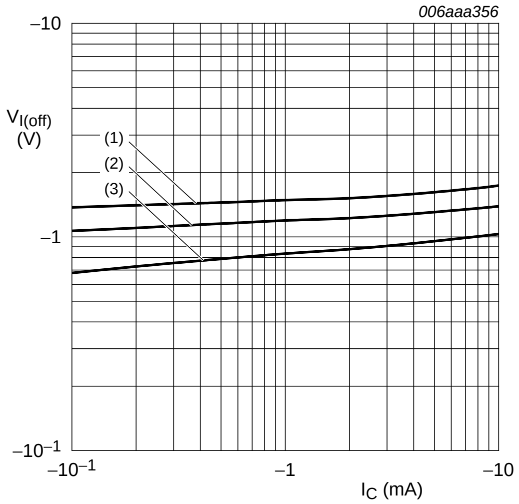
V_{CE} = –0.3 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

Fig 20. PDTB123EU: On-state input voltage as a function of collector current; typical values



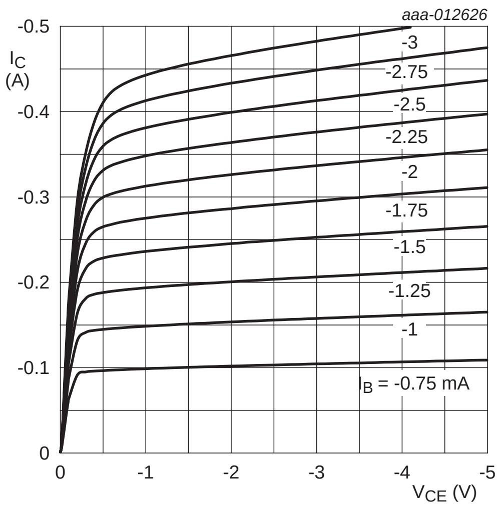
V_{CE} = –5 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

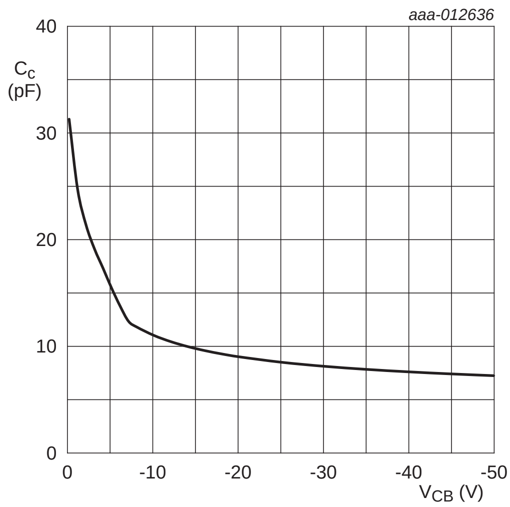
(3) T_{amb} = 100 °C

Fig 21. PDTB123EU: Off-state input voltage as a function of collector current; typical values



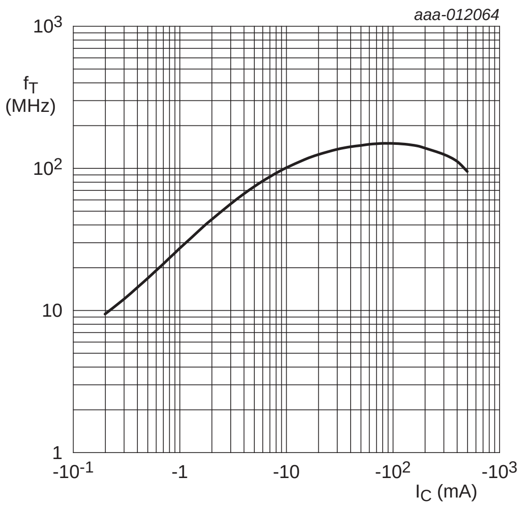
T_{amb} = 25 °C

Fig 22. PDTB123EU: Collector current as a function of collector-emitter voltage; typical values



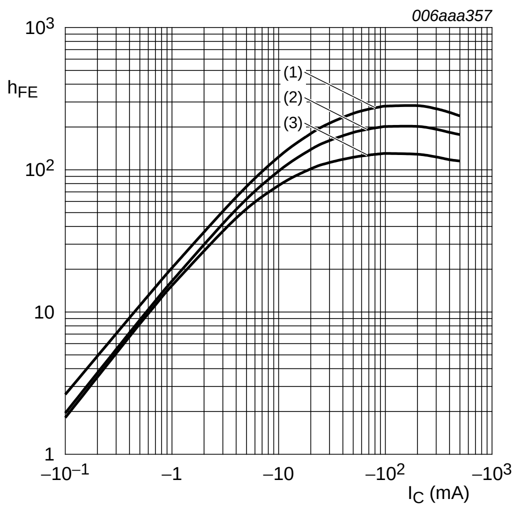
f = 1 MHz; T_{amb} = 25 °C

Fig 23. PDTB123EU: Collector capacitance as a function of collector-base voltage; typical values



V_{CE} = –5 V; T_{amb} = 25 °C

Fig 24. PDTB123EU: Transition frequency as a function of collector current; typical values of built-in transistor



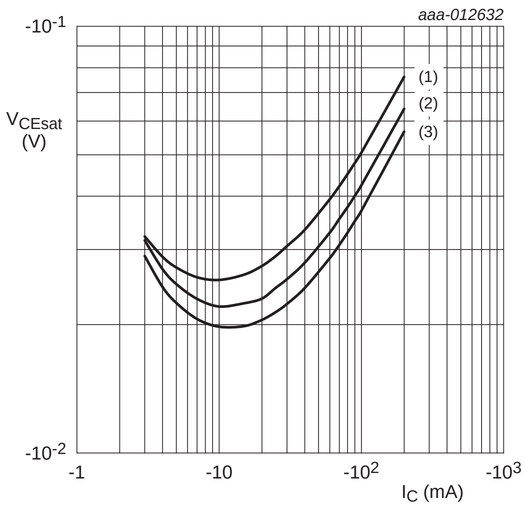
$V_{CE} = -5$ V

(1) $T_{amb} = 100$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = -40$ °C

Fig 25. PDTB123YU: DC current gain as a function of collector current; typical values



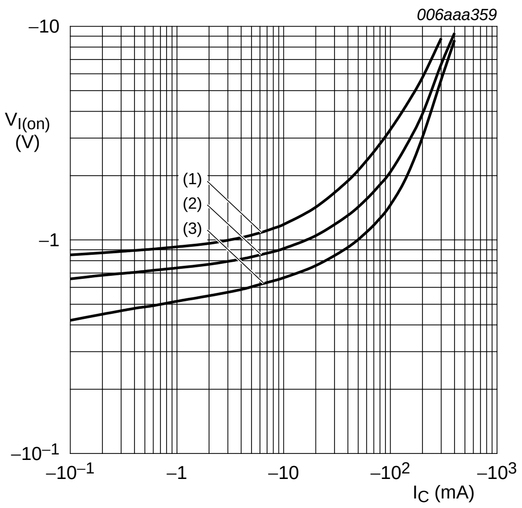
$I_C/I_B = 20$

(1) $T_{amb} = 100$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = -40$ °C

Fig 26. PDTB123YU: Collector-emitter saturation voltage as a function of collector current; typical values



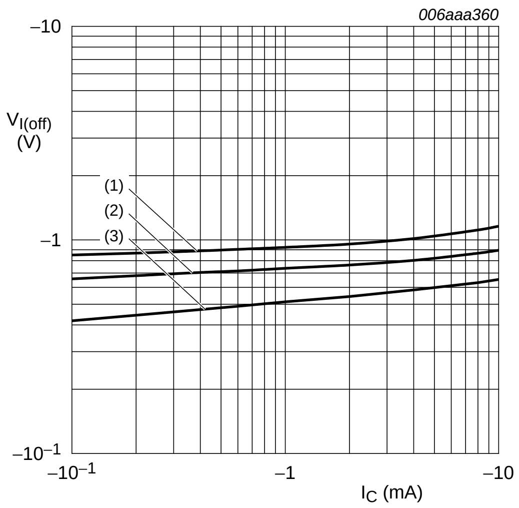
$V_{CE} = -0.3$ V

(1) $T_{amb} = -40$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = 100$ °C

Fig 27. PDTB123YU: On-state input voltage as a function of collector current; typical values



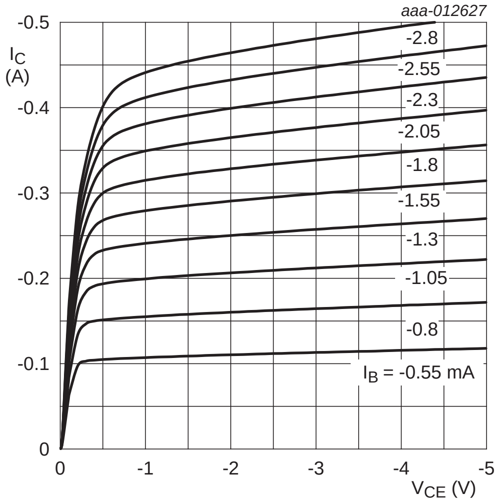
$V_{CE} = -5$ V

(1) $T_{amb} = -40$ °C

(2) $T_{amb} = 25$ °C

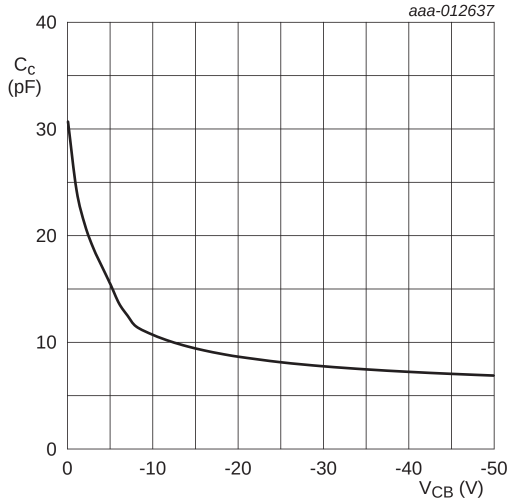
(3) $T_{amb} = 100$ °C

Fig 28. PDTB123YU: Off-state input voltage as a function of collector current; typical values



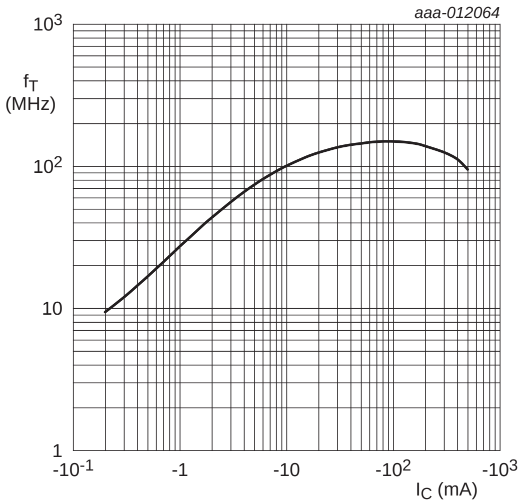
T_{amb} = 25 °C

Fig 29. PDTB123YU: Collector current as a function of collector-emitter voltage; typical values



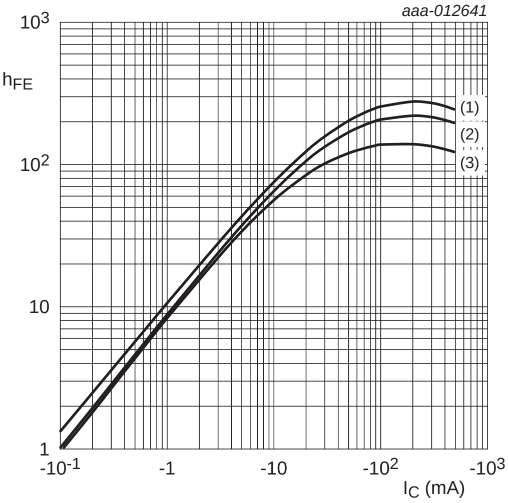
f = 1 MHz; T_{amb} = 25 °C

Fig 30. PDTB123YU: Collector capacitance as a function of collector-base voltage; typical values



V_{CE} = –5 V; T_{amb} = 25 °C

Fig 31. PDTB123YU: Transition frequency as a function of collector current; typical values of built-in transistor



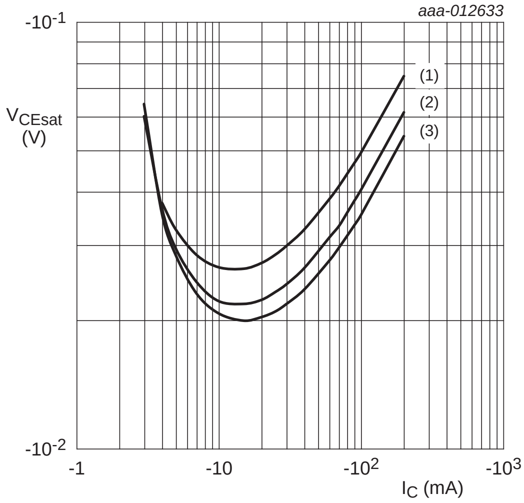
$V_{CE} = -5$ V

(1) $T_{amb} = 100$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = -40$ °C

Fig 32. PDTB143EU: DC current gain as a function of collector current; typical values



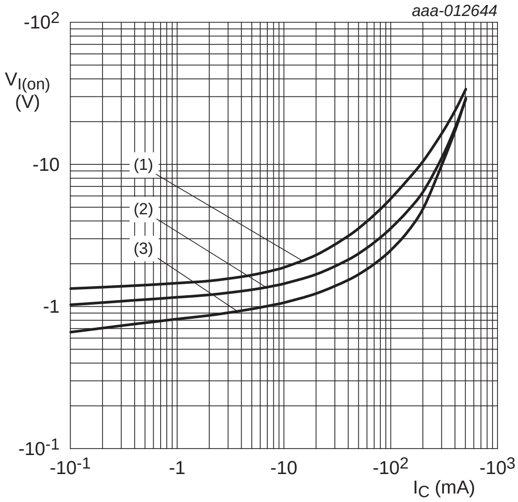
$I_C/I_B = 20$

(1) $T_{amb} = 100$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = -40$ °C

Fig 33. PDTB143EU: Collector-emitter saturation voltage as a function of collector current; typical values



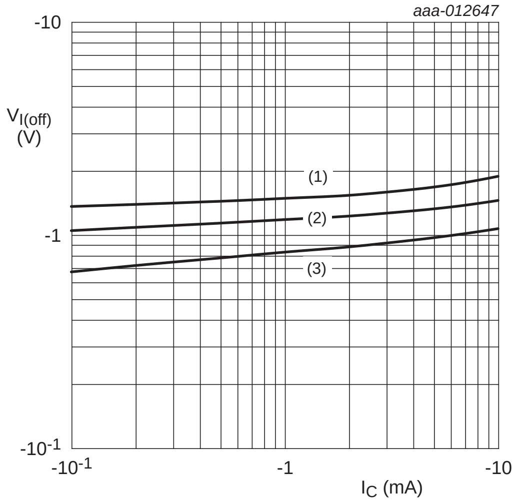
$V_{CE} = -0.3$ V

(1) $T_{amb} = -40$ °C

(2) $T_{amb} = 25$ °C

(3) $T_{amb} = 100$ °C

Fig 34. PDTB143EU: On-state input voltage as a function of collector current; typical values



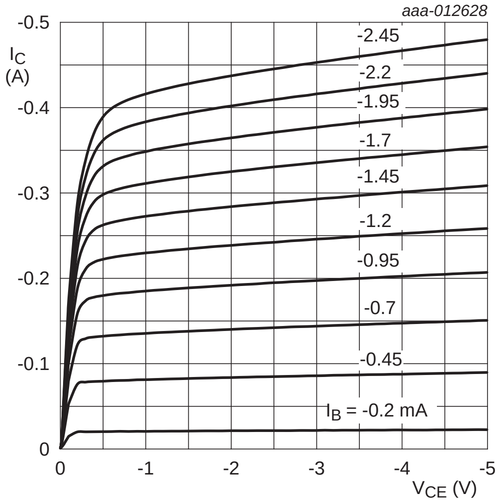
$V_{CE} = -5$ V

(1) $T_{amb} = -40$ °C

(2) $T_{amb} = 25$ °C

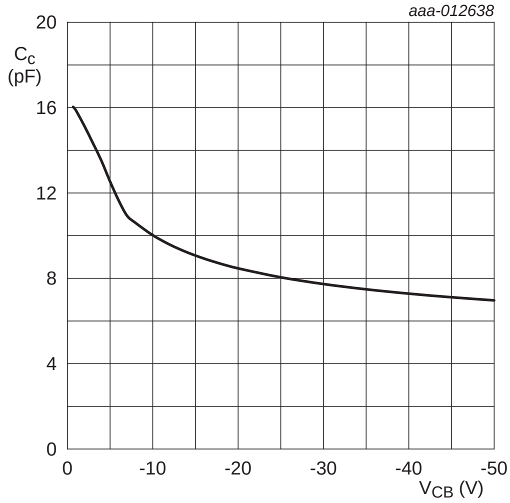
(3) $T_{amb} = 100$ °C

Fig 35. PDTB143EU: Off-state input voltage as a function of collector current; typical values



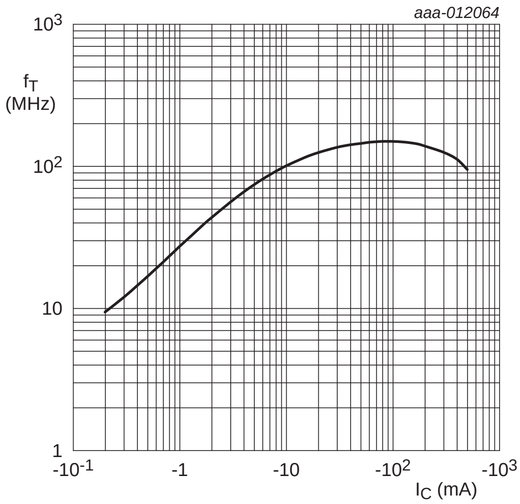
T_{amb} = 25 °C

Fig 36. PDTB143EU: Collector current as a function of collector-emitter voltage; typical values



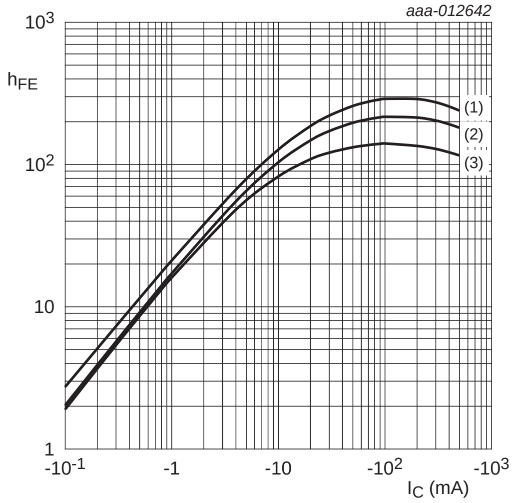
f = 1 MHz; T_{amb} = 25 °C

Fig 37. PDTB143EU: Collector capacitance as a function of collector-base voltage; typical values



V_{CE} = –5 V; T_{amb} = 25 °C

Fig 38. PDTB143EU: Transition frequency as a function of collector current; typical values of built-in transistor



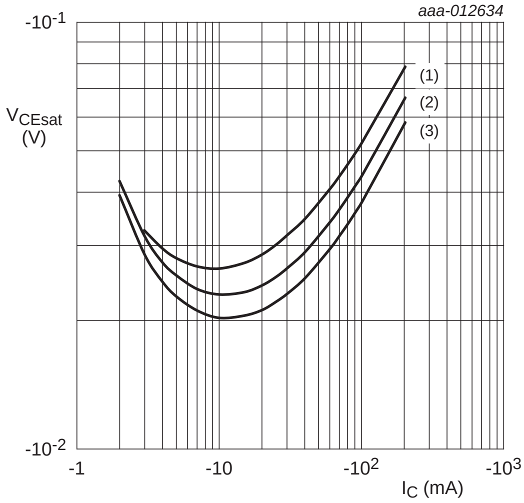
V_{CE} = –5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = –40 °C

Fig 39. PDTB143XU: DC current gain as a function of collector current; typical values



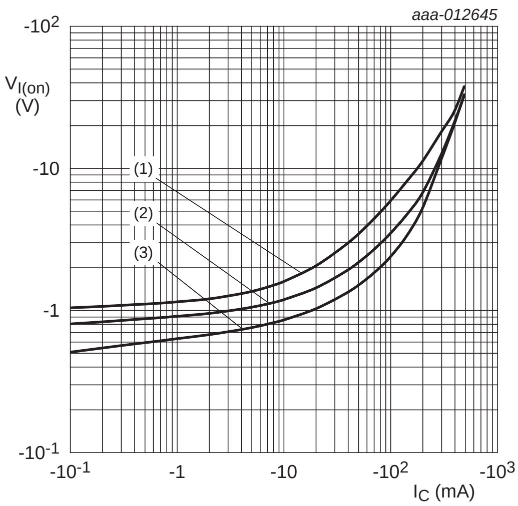
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = –40 °C

Fig 40. PDTB143XU: Collector-emitter saturation voltage as a function of collector current; typical values



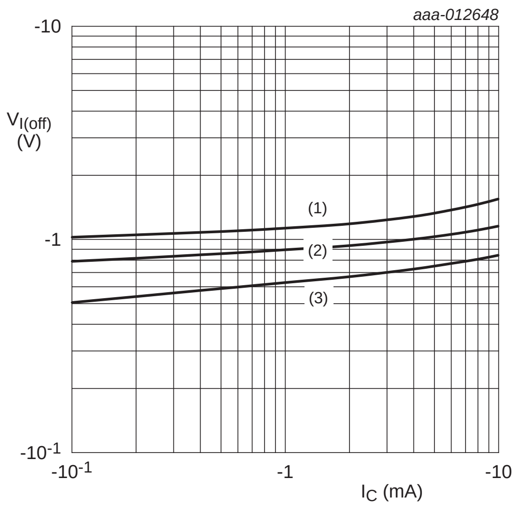
V_{CE} = –0.3 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

Fig 41. PDTB143XU: On-state input voltage as a function of collector current; typical values



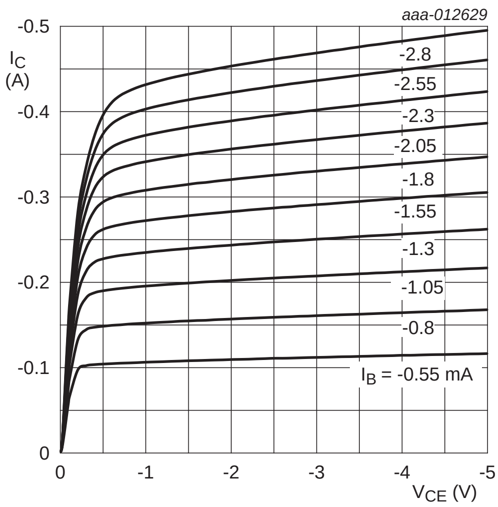
V_{CE} = –5 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

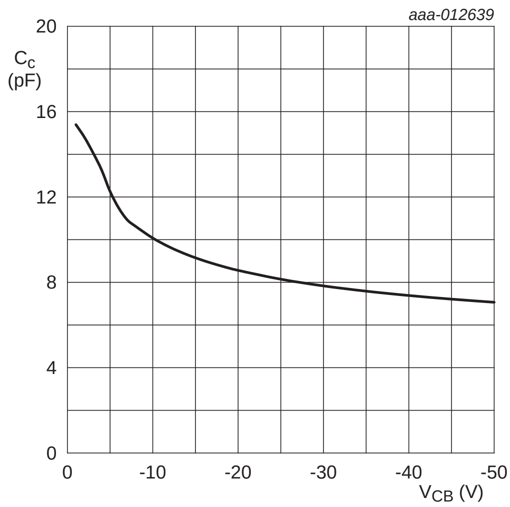
(3) T_{amb} = 100 °C

Fig 42. PDTB143XU: Off-state input voltage as a function of collector current; typical values



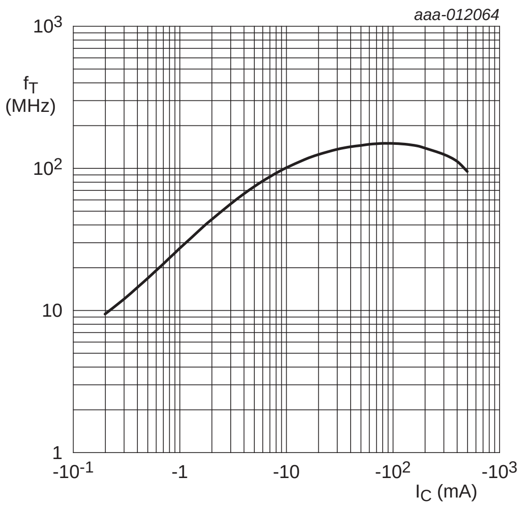
T_{amb} = 25 °C

Fig 43. PDTB143XU: Collector current as a function of collector-emitter voltage; typical values



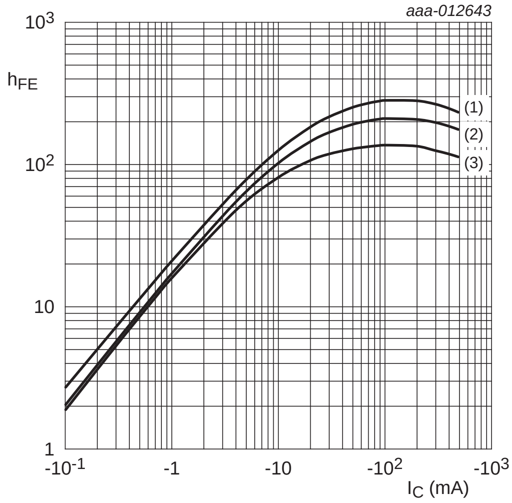
f = 1 MHz; T_{amb} = 25 °C

Fig 44. PDTB143XU: Collector capacitance as a function of collector-base voltage; typical values



V_{CE} = –5 V; T_{amb} = 25 °C

Fig 45. PDTB143XU: Transition frequency as a function of collector current; typical values of built-in transistor



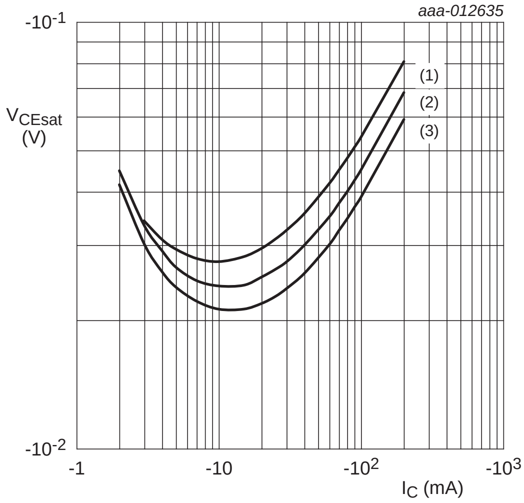
V_{CE} = –5 V

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = –40 °C

Fig 46. PDTB114EU: DC current gain as a function of collector current; typical values



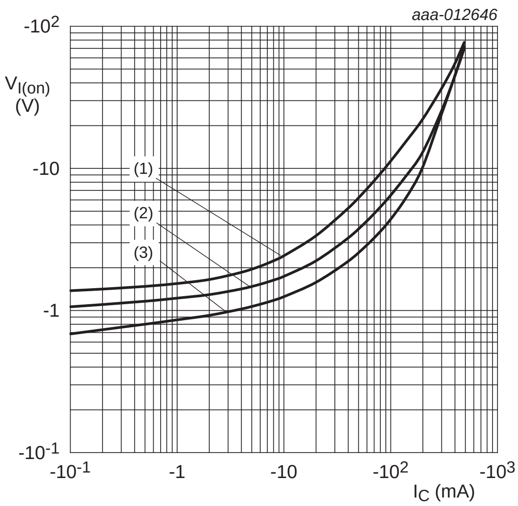
I_C/I_B = 20

(1) T_{amb} = 100 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = –40 °C

Fig 47. PDTB114EU: Collector-emitter saturation voltage as a function of collector current; typical values



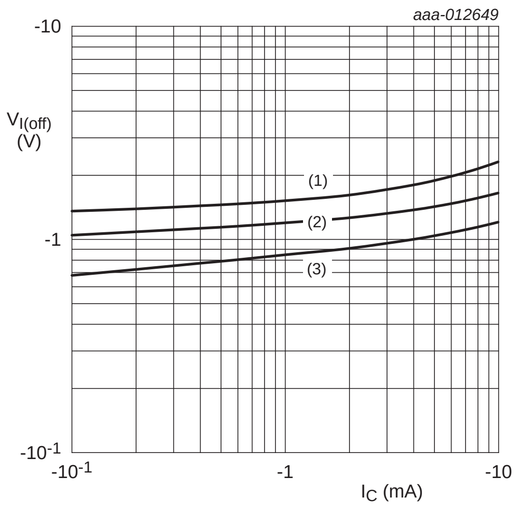
V_{CE} = –0.3 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

(3) T_{amb} = 100 °C

Fig 48. PDTB114EU: On-state input voltage as a function of collector current; typical values



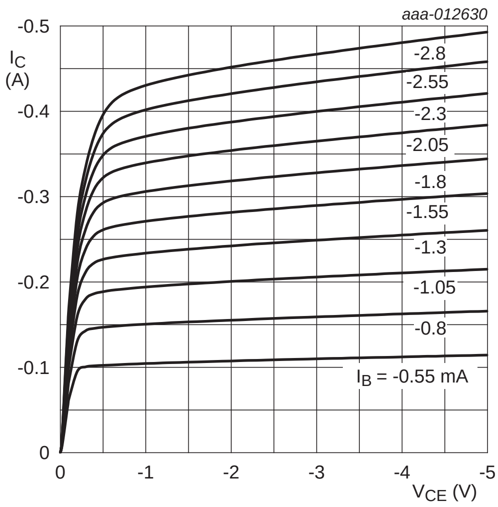
V_{CE} = –5 V

(1) T_{amb} = –40 °C

(2) T_{amb} = 25 °C

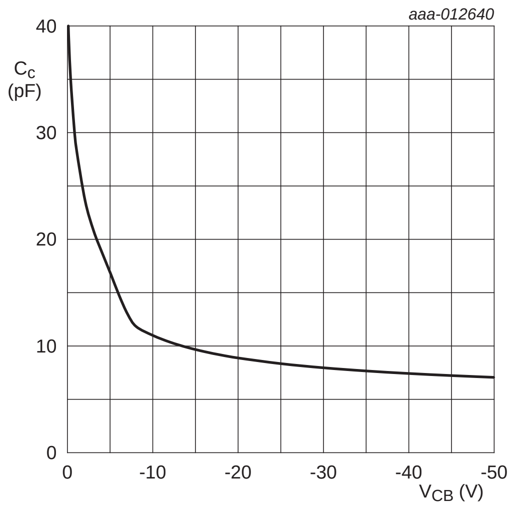
(3) T_{amb} = 100 °C

Fig 49. PDTB114EU: Off-state input voltage as a function of collector current; typical values



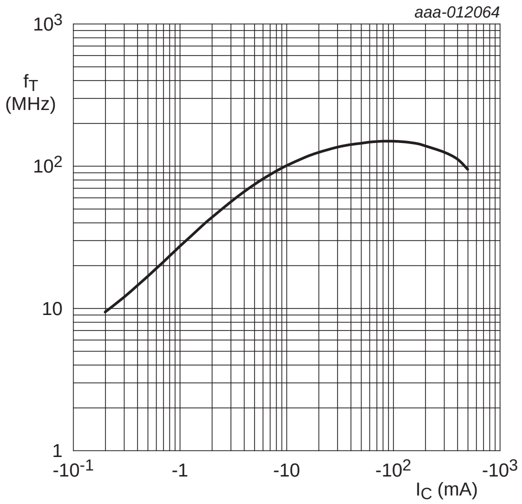
T_{amb} = 25 °C

Fig 50. PDTB114EU: Collector current as a function of collector-emitter voltage; typical values



f = 1 MHz; T_{amb} = 25 °C

Fig 51. PDTB114EU: Collector capacitance as a function of collector-base voltage; typical values of built-in transistor



V_{CE} = –5 V; T_{amb} = 25 °C

Fig 52. PDTB114EU: Transition frequency as a function of collector current; typical values of built-in transistor

8. Test information

8.1 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.

9. Package outline

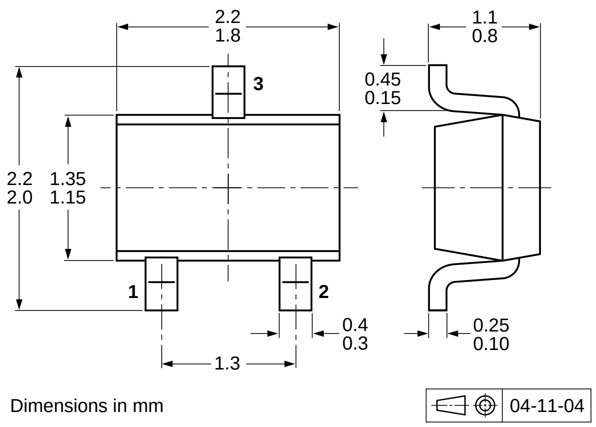
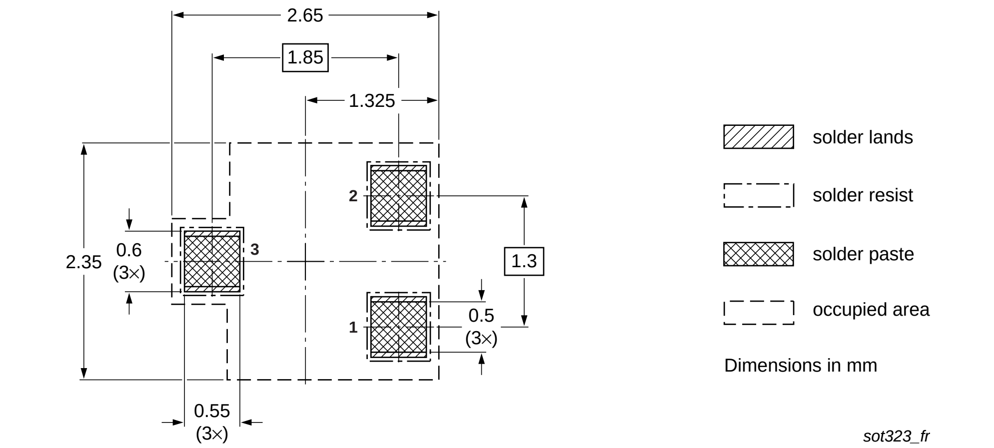


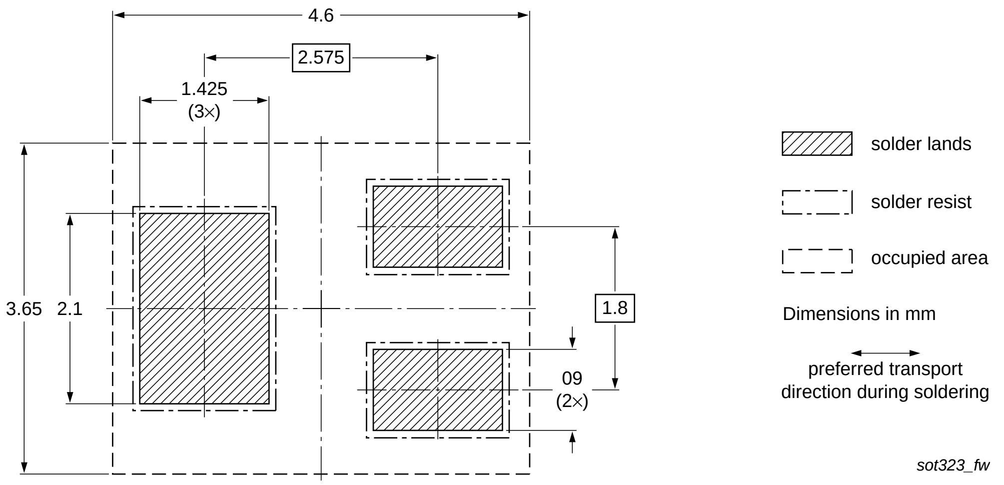
Fig 53. Package outline PDTB1xxxU series (SOT323/SC-70)

10. Soldering



Dimensions in mm

Fig 54. Reflow soldering footprint PDTB1xxxU series (SOT323/SC-70)



Dimensions in mm

Fig 55. Wave soldering footprint PDTB1xxxU series (SOT323/SC-70)

11. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PDTB1XXXU_SER v.1	20140506	Product data sheet	-	-

12. Legal information

12.1 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 URL http://www.nexperia.com.

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For sales office addresses, please send an email to: **salesaddresses@nexperia.com**

14. Contents