N-P-N SILICON PLANAR EPITAXIAL TRANSISTORS

BC147
BC148
BC149

N-P-N silicon planar epitaxial transistors in plastic encapsulation with three rigid self-locking strips suitable for insertion in printed circuit boards using standard grids.

The BC147 is primarily intended for use in audio driver stages and television signal processing circuits.

The BC148 is a general purpose 1.f. transistor.

The BC149 is primarily intended for low noise audio input stages.

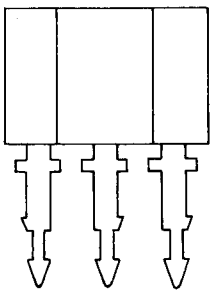
QUICK REFERENCE DATA

			BC147	BC148	BC149	
V_{CES} max.			50	30	30	V
V_{CEO} max.			45	20	20	V
I_{CM} max.			200	200	200	mA
P_{tot} max. ($T_{amb} \leq 25^{o}C$)			350	350	350	mW
T_j max.			125	125	125	^{o}C
h_{fe} ($I_C = 2mA$, $V_{CE} = 5V$, $f = 1kHz$)		min.	125	125	240	
		max.	500	900	900	
f_T ($I_C = 10mA$, $V_{CE} = 5V$, $f = 35MHz$)		typ.	300	300	300	MHz
N ($I_C = 200\mu A$, $V_{CE} = 5V$, $R_S = 2k\Omega$)						
$f = 30Hz$ to $15kHz$		typ.	-	-	1.4	dB
		max.	-	-	4.0	dB
$f = 1kHz$, $B = 200Hz$		max.	10	10	4.0	dB

Unless otherwise stated data are applicable to all types

OUTLINE AND DIMENSIONS

For details see page 5.



Front View
Scale 3:1

D5542

N.B. Devices in this Data Sheet should be ordered by the type number followed by Reference 0220.

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

	BC147	BC148	BC149	
V_{CBO} max.	50	30	30	V
V_{CES} max.	50	30	30	V
V_{CEO} max.	45	20	20	V
V_{EBO} max.	6.0	5.0	5.0	V
I_C max.	100	100	100	mA
I_{CM} max.	200	200	200	mA
$-I_{EM}$ max.	200	200	200	mA
I_{BM} max.	200	200	200	mA
P_{tot} max. ($T_{amb} \leq 25^oC$)	350	350	350	mW

Temperature

T_{stg} range	-65 to +125	^oC
T_j max.	125	^oC

THERMAL CHARACTERISTICS

$R_{th(j-amb)}$	0.275	$^oC/mW$

ELECTRICAL CHARACTERISTICS ($T_j = 25^oC$ unless otherwise stated)

		Min.	Typ.	Max.	
I_{CBO}	Collector cut-off current				
	$V_{CB}=20V$, $I_E=0$, $T_j=125^oC$	-	-	5.0	μA
	$V_{CB}=20V$, $I_E=0$	-	0.01	0.6	μA
V_{BE}	*Base-emitter voltage				
	$I_C=2.0mA$, $V_{CE}=5.0V$	550	620	700	mV
	$I_C=10mA$, $V_{CE}=5.0V$	-	-	770	mV
$V_{CE(sat)}$	Collector-emitter saturation voltage				
	$I_C=10mA$, $I_B=0.5mA$	-	90	250	mV
	$I_C=100mA$, $I_B=5.0mA$	-	200	600	mV
$V_{BE(sat)}$	†Base-emitter saturation voltage				
	$I_C=10mA$, $I_B=0.5mA$	-	700	-	mV
	$I_C=100mA$, $I_B=5.0mA$	-	900	-	mV

*V_{BE} decreases by about $2mV/^oC$ with increasing temperature.

†$V_{BE(sat)}$ decreases by about $1.7mV/^oC$ with increasing temperature.

ELECTRICAL CHARACTERISTICS (contd.)		Min.	Typ.	Max.	
V_{CEK}	Collector knee voltage (see Fig. 1) I_C = 10mA, I_B = the value for which I_C = 11mA at V_{CE} = 1.0V	-	300	600	mV

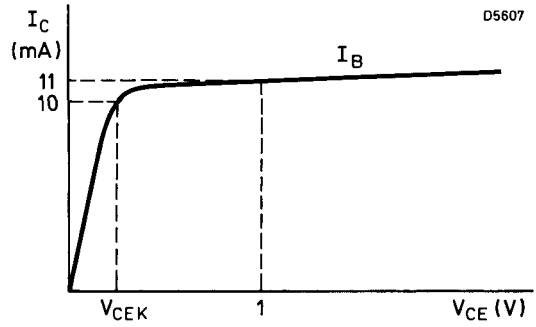


Fig. 1

h_{FE}	Static forward current transfer ratio I_C = 2.0mA, V_{CE} = 5.0V	BC147	110	-	450	
		BC148	110	-	800	
		BC149	200	-	800	
h_{fe}	Small signal forward current transfer ratio I_C = 2.0mA, V_{CE} = 5.0V, f = 1.0kHz					
		BC147	125	-	500	
		BC148	125	-	900	
		BC149	240	-	900	
f_T	Transition frequency I_C = 10mA, V_{CE} = 5.0V, f = 35MHz		-	300	-	MHz
C_{Tc}	Collector capacitance $I_E = I_e$ = 0, V_{CB} = 10V, f = 1.0MHz		-	2.5	4.5	pF
C_{Te}	Emitter capacitance $I_C = I_c$ = 0, V_{EB} = 0.5V, f = 1.0MHz		-	9.0	-	pF
N	Noise figure I_C = 0.2mA, V_{CE} = 5.0V, R_S = 2.0kΩ					
	f = 30Hz to 15kHz	BC149	-	1.4	4.0	dB
	f = 1.0kHz, B = 200Hz	BC147/148	-	2.0	10	dB
		BC149	-	1.2	4.0	dB

ELECTRICAL CHARACTERISTICS (contd.)

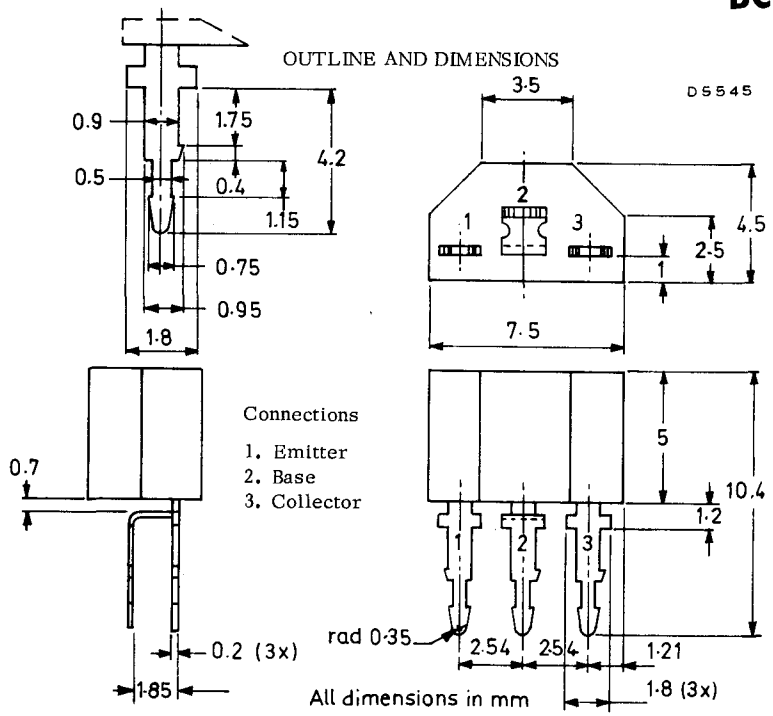
The following supplementary gain groups are available on request: -

			BC147A BC148A	BC147B BC148B BC149B	BC148C BC149C	
h_{FE}	Static forward current transfer ratio					
	$I_C = 10\mu A$, $V_{CE} = 5.0V$	min.	-	40	100	
		typ.	90	150	270	
	$I_C = 2.0mA$, $V_{CE} = 5.0V$	min.	110	200	420	
		typ.	180	290	520	
		max.	220	450	800	
h parameters	$I_C = 2.0mA$, $V_{CE} = 5.0V$, $f = 1.0kHz$					
h_{ie}	Input impedance	min.	1.6	3.2	6.0	kΩ
		typ.	2.7	4.5	8.7	kΩ
		max.	4.5	8.5	15	kΩ
h_{re}	Voltage feedback ratio	typ.	1.5	2.0	3.0	$\times 10^{-4}$
h_{fe}	Small signal current gain	min.	125	240	450	
		typ.	220	330	600	
		max.	260	500	900	
h_{oe}	Output admittance	typ.	18	30	60	μA/V
		max.	30	60	110	μA/V

N-P-N SILICON PLANAR EPITAXIAL TRANSISTORS

BC147
BC148
BC149

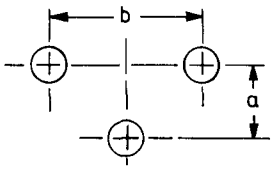
OUTLINE AND DIMENSIONS



Connections

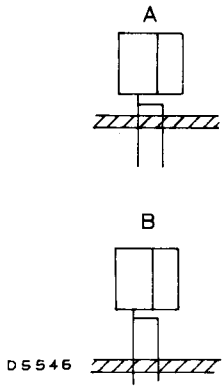
1. Emitter
2. Base
3. Collector

Mounting details



a = 2.49 to 2.59mm

b = 5.03 to 5.13mm



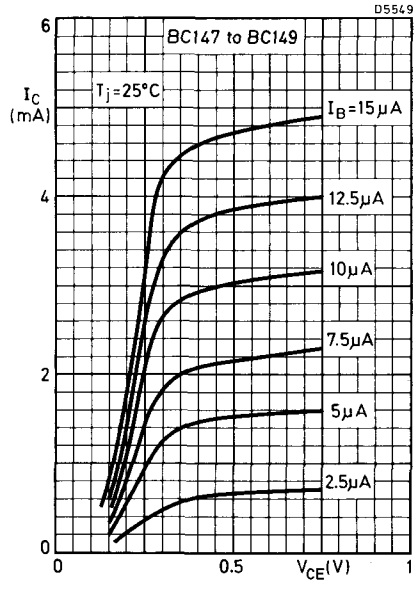
Maximum thickness of printed board = 1.7mm

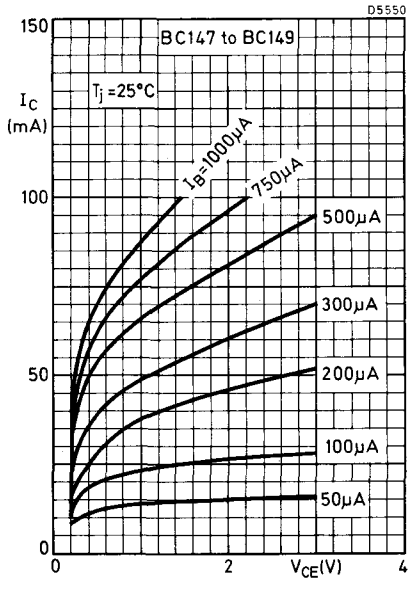
Recommended hole diameter = 1.0 to 1.1mm (1.0 to 1.3mm allowable)

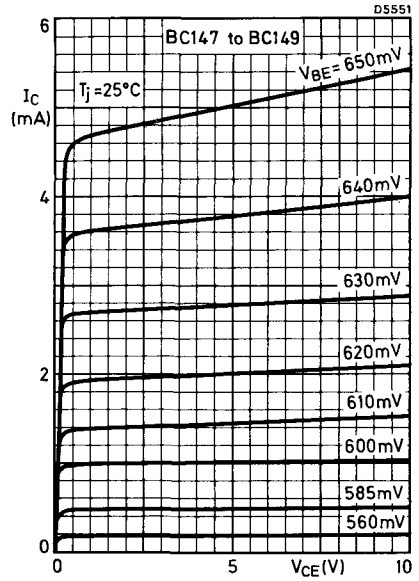
Maximum thickness of printed board = 1.1mm

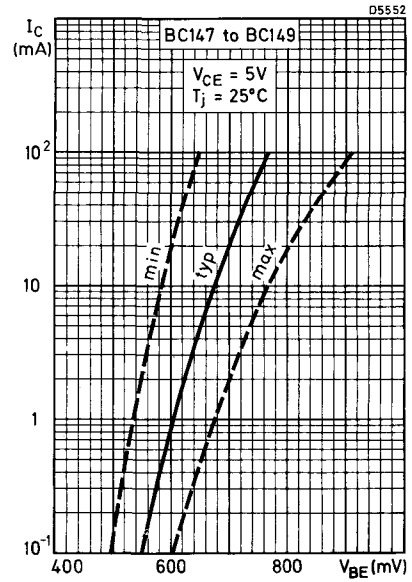
Hole diameter = 0.77 to 0.83mm

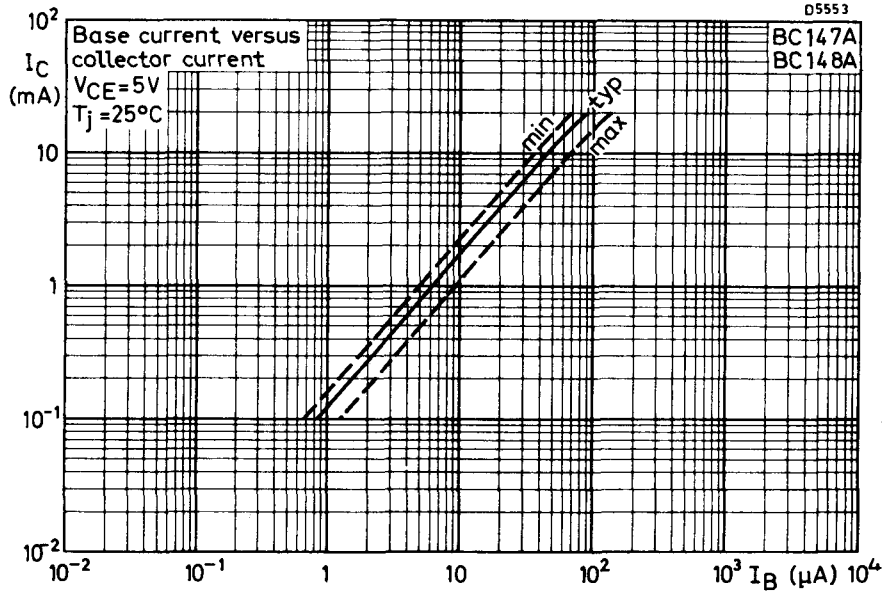
See also General Explanatory Notes Section IV.

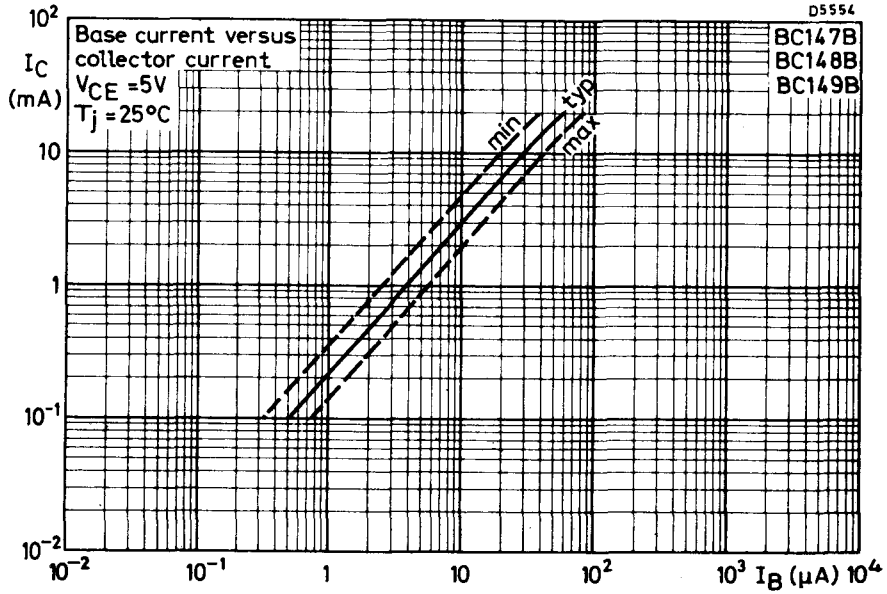

D5549
BC147 to BC149
T_j=25°C
I_C (mA)
I_B=15μA
12.5μA
10μA
7.5μA
5μA
2.5μA
0
0.5
V_{CE}(V)
1
2
4
6

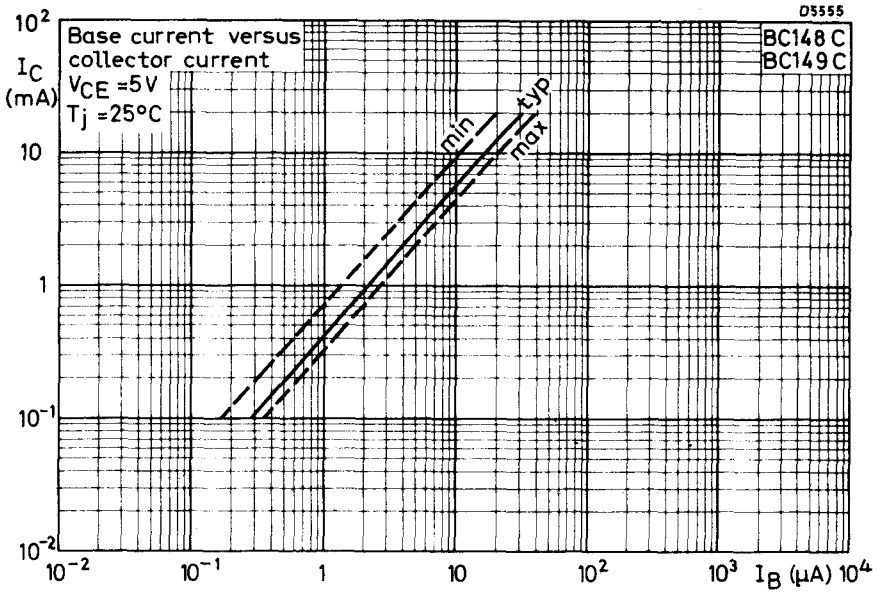

D5550
BC147 to BC149
T_j=25°C
I_C (mA)
I_B=1000μA
750μA
500μA
300μA
200μA
100μA
50μA
0
2
V_{CE}(V)
4
50
100
150

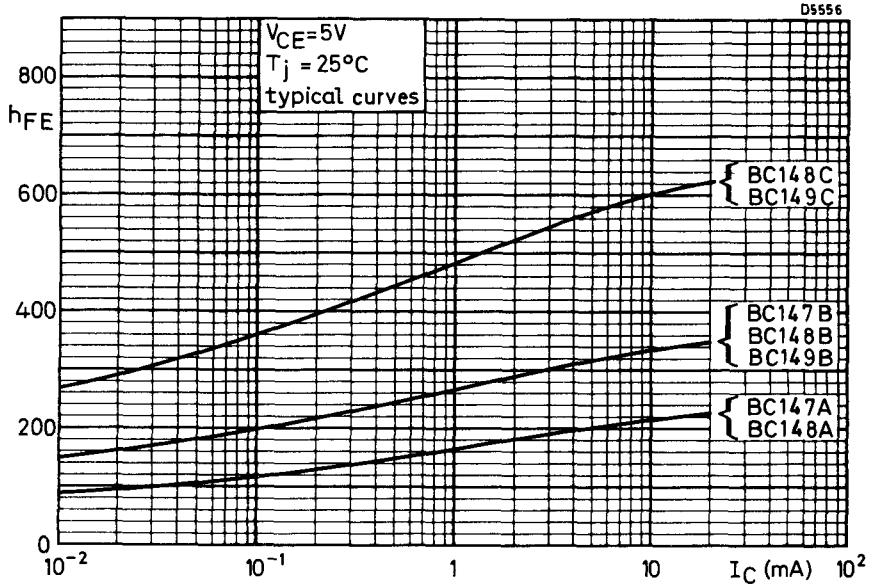

D5551
BC147 to BC149
T_j=25°C
I_C (mA)
V_{BE}=650mV
640mV
630mV
620mV
610mV
600mV
585mV
560mV
0
5
V_{CE}(V)
10
2
4
6

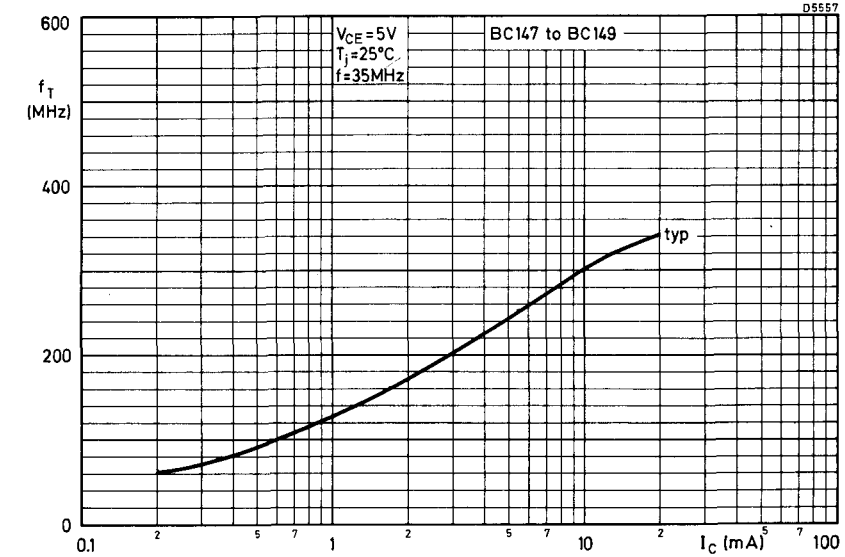

D5552
BC147 to BC149
V_{CE} = 5V
T_j = 25°C
I_C (mA)
min
typ
max
400
600
800
V_{BE}(mV)
10^2
10
1
10^{-1}

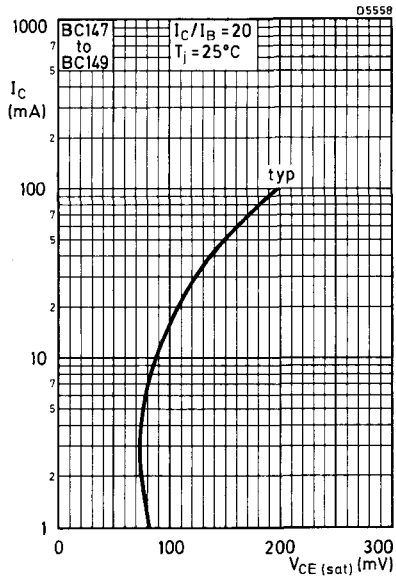

D5553
Base current versus
collector current
V_{CE}=5V
T_j=25°C
BC147A
BC148A
min
typ
max
I_C (mA)
10^2
10
1
10^{-1}
10^{-2}
10^{-2}
10^{-1}
1
10
10^2
10^3 I_B (μA) 10^4

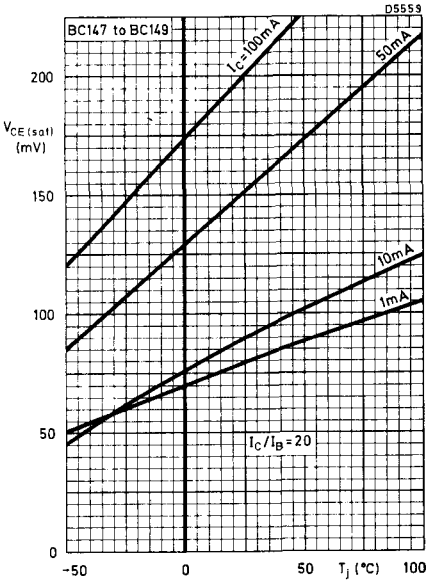

D5554
Base current versus
collector current
V_{CE}=5V
T_j=25°C
BC147B
BC148B
BC149B
min
typ
max
I_C (mA)
10^2
10
1
10^{-1}
10^{-2}
10^{-2}
10^{-1}
1
10
10^2
10^3 I_B (μA) 10^4

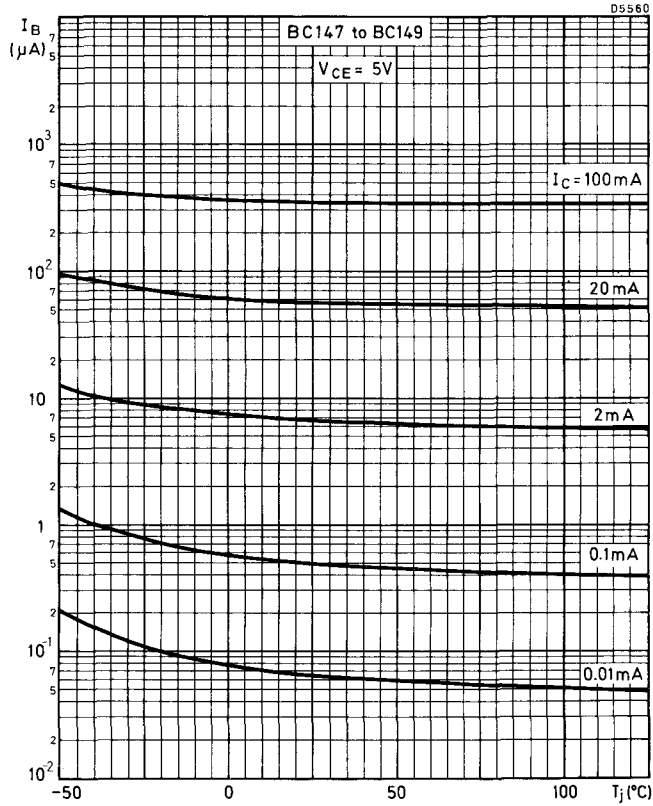

D5555
Base current versus collector current
V_{CE} =5V
T_j =25°C
BC148C
BC149C
min
typ
max
I_C (mA)
10^2
10
1
10^{-1}
10^{-2}
10^{-2}
10^{-1}
1
10
10^2
10^3
I_B (µA)
10^4

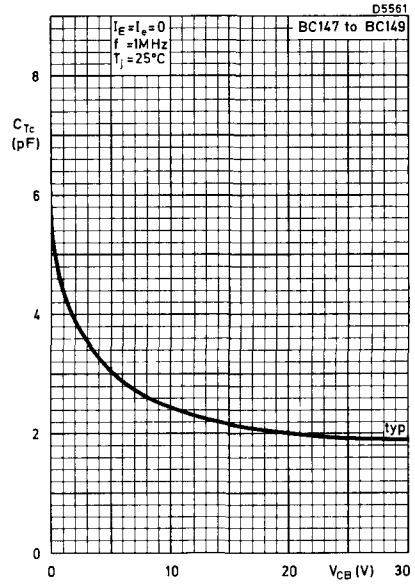

D5556
V_{CE}=5V
T_j = 25°C
typical curves
h_{FE}
800
600
400
200
0
BC148C
BC149C
BC147B
BC148B
BC149B
BC147A
BC148A
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2

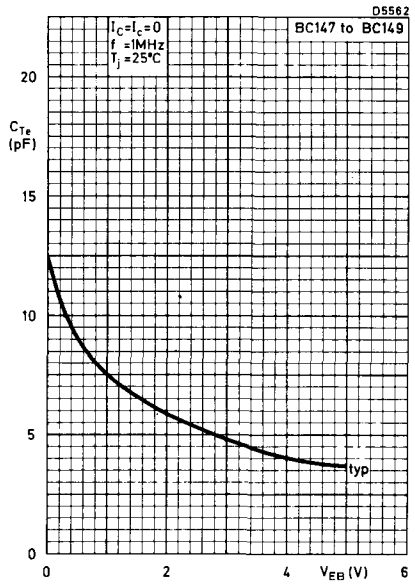

D5557
600
400
200
0
f_T (MHz)
V_{CE} = 5V
T_j = 25°C
f = 35MHz
BC147 to BC149
typ
0.1
1
10
100
I_C (mA)

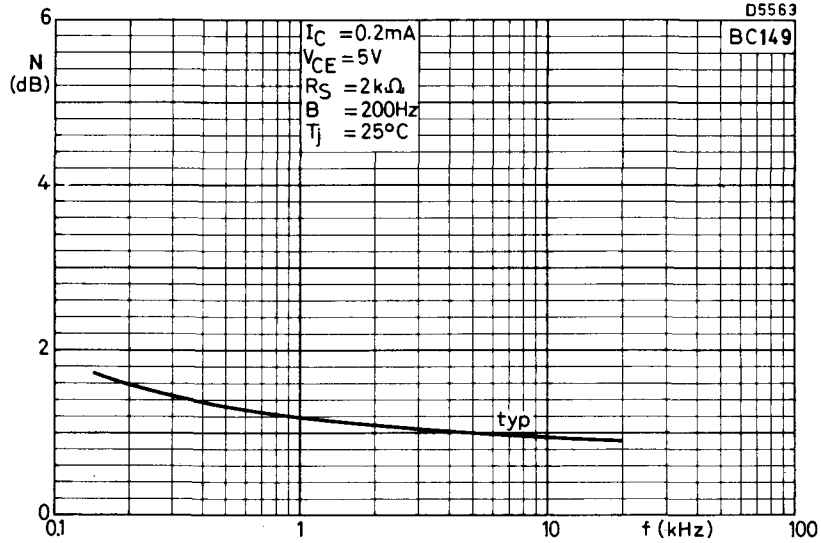

D5558
1000
100
10
1
I_C (mA)
BC147 to BC149
I_C/I_B = 20
T_j = 25°C
typ
0
100
200
300
$V_{CE\,(sat)}$ (mV)

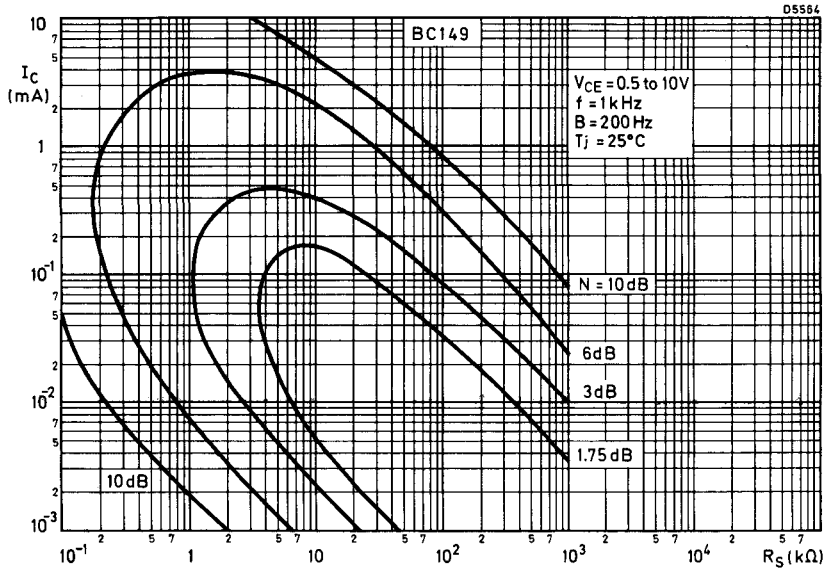

D5559
BC147 to BC149
I_C = 100mA
50mA
10mA
1mA
I_C/I_B = 20
200
150
100
50
0
$V_{CE\,(sat)}$ (mV)
-50
0
50
100
T_j (°C)

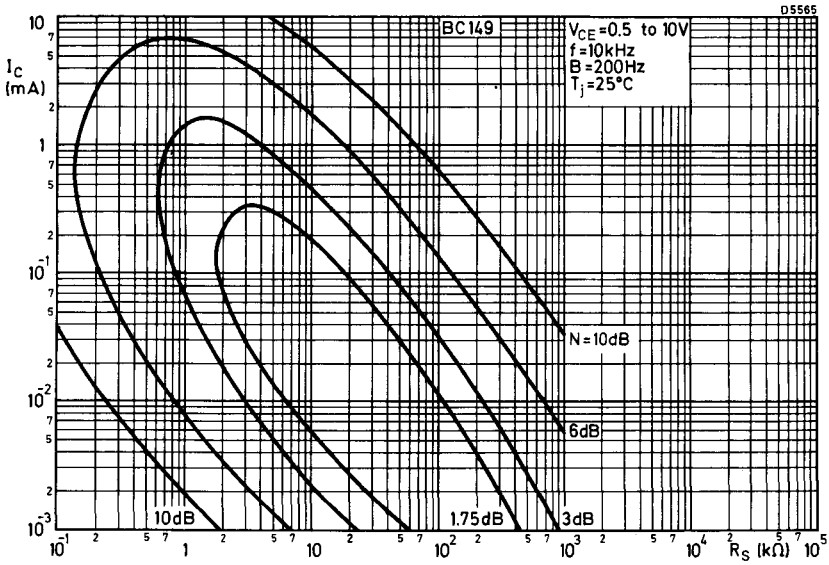

D5560
BC147 to BC149
V_{CE} = 5V
I_B (μA)
I_C = 100 mA
20 mA
2 mA
0.1 mA
0.01 mA
10^3
10^2
10
1
10^{-1}
10^{-2}
−50
0
50
100
T_j (°C)


D5561
$I_E = I_e = 0$
f = 1MHz
T_j = 25°C
BC147 to BC149
C_{Tc} (pF)
8
6
4
2
0
typ
0
10
20
V_{CB} (V)
30

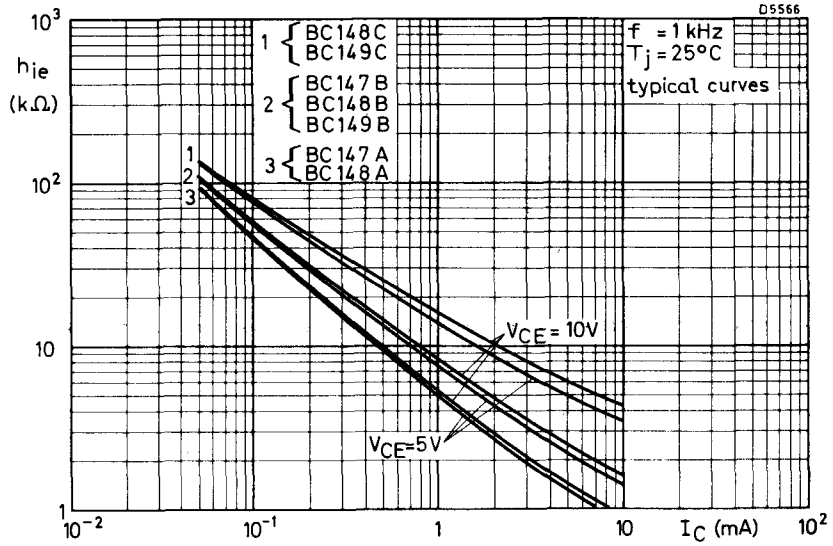

D5562
$I_C = I_c = 0$
f = 1MHz
T_j = 25°C
BC147 to BC149
C_{Te} (pF)
20
15
10
5
0
typ
0
2
4
V_{EB} (V)
6

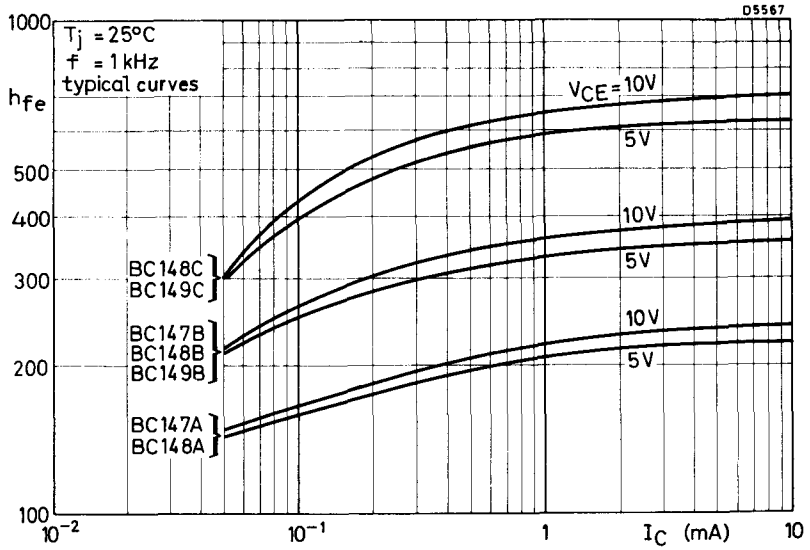

D5563
BC149
I_C = 0.2mA
V_{CE} = 5V
R_S = 2kΩ
B = 200Hz
T_j = 25°C
N (dB)
6
4
2
0
typ
0.1
1
10
f (kHz)
100

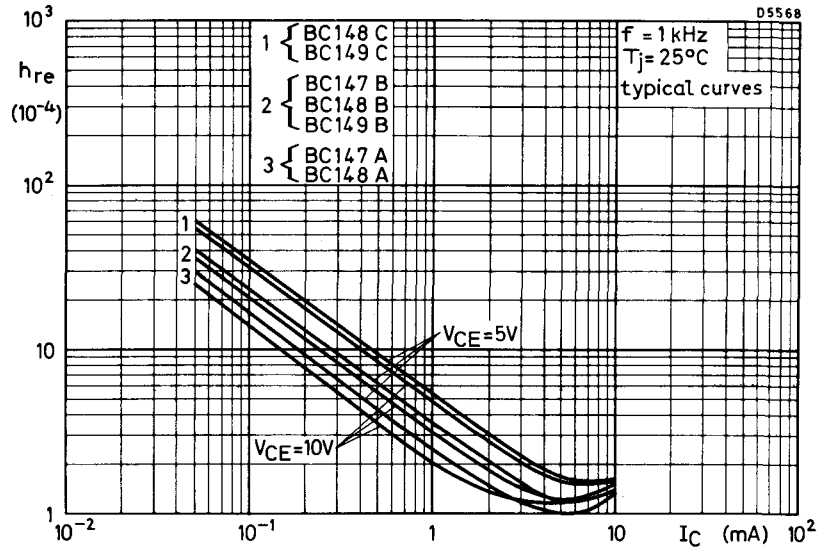


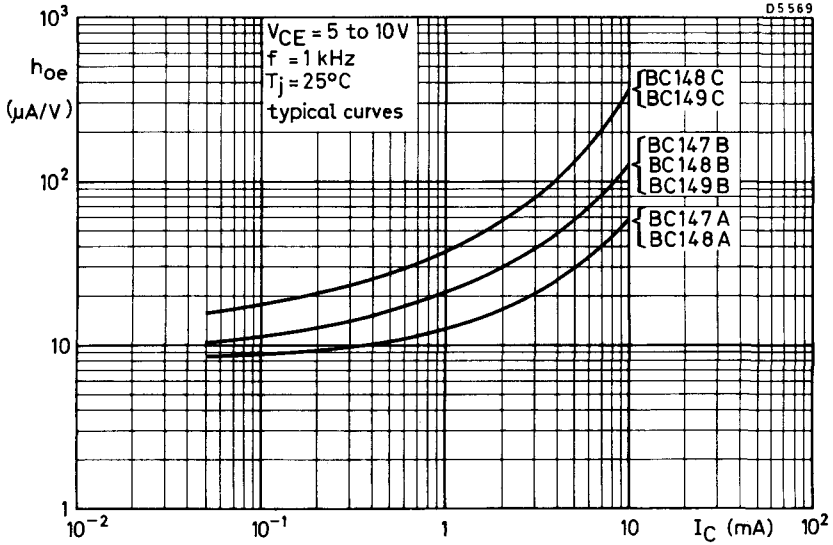


TYPICAL CURVES OF CONSTANT NOISE FIGURE


D5566
10^3
h_{ie}
(kΩ)
10^2
10
1
1 { BC148C BC149C
2 { BC147B BC148B BC149B
3 { BC147A BC148A
f = 1 kHz
T_j = 25°C
typical curves
V_{CE} = 10V
V_{CE}=5V
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2


D5567
1000
h_{fe}
500
400
300
200
100
T_j = 25°C
f = 1 kHz
typical curves
V_{CE} = 10V
5V
10V
5V
10V
5V
BC148C
BC149C
BC147B
BC148B
BC149B
BC147A
BC148A
10^{-2}
10^{-1}
1
I_C (mA)
10


D5568
10^3
h_{re}
(10^{-4})
10^2
10
1
1 { BC148 C
BC149 C
2 { BC147 B
BC148 B
BC149 B
3 { BC147 A
BC148 A
f = 1 kHz
T_j = 25°C
typical curves
1
2
3
V_{CE}=5V
V_{CE}=10V
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2


D5569
10^3
h_{oe}
(μA/V)
10^2
10
1
V_{CE} = 5 to 10 V
f = 1 kHz
T_j = 25°C
typical curves
BC148 C
BC149 C
BC147 B
BC148 B
BC149 B
BC147 A
BC148 A
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2